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THE STUDY OF CHILDREN

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No. 2 March — *Geography in the Horace Mann Schools.* — RICHARD E. DODGE and Miss C. B. KIRCHWEY.

No. 3 May — *Child Study. — Sources of Material and Syllabi of College Courses.* — Professor E. L. THORNDIKE.

The following number in preparation:

Syllabi of Teachers College Courses on the Theory and Practice of Teaching. — Professor F. M. MCMURRY.

Address all communications to

The Editor of Teachers College Record

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TEACHERS COLLEGE RECORD

VOL. II MAY, 1901 No. 3

THE STUDY OF CHILDREN

BY EDWARD L. THORNDIKE

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Preface

The purpose of this number of the RECORD is to give an account of the work done by the department of psychology in Teachers College, and to present some of the more important data of Child Study in a form accessible to all students of children and convenient for teachers of special subjects. It will comprise brief statements of the nature and aims of the different courses offered, a more detailed account of the elementary course in Child Study, reprints of two valuable general articles now practically inaccessible to most students, and sample contributions from the literature of Child Study to the methods of teaching the separate subjects.

WORK IN PSYCHOLOGY AT TEACHERS COLLEGE

Introductory Course

Psychology A is a course in the scientific study of human nature and intelligence. It aims to preserve such breadth and rigor of treatment as fits a course for an academic degree and still to meet the peculiar wants of the prospective teacher. The latter end is attained by the selection of topics and by the use of illustrations from school life whenever possible. Semi-metaphys-

ical questions, such as the nature of the self, the nature of knowledge or the supra-phenomenal relation of mind and body, are entirely eliminated. Any detailed study of the physiology of the sense organs, of the relation of stimulus to sensation, or of the minute analysis of mental states into hypothetical elements, is dispensed with. Emphasis is laid upon the description of mental phenomena, an understanding of their neural basis, and especially upon the mental life in function, upon mental states in action.

Psychology A may serve as an introduction to the courses in experimental, physiological, abnormal, philosophical or genetic psychology, and to the courses in general method.

The work in all but the last two fields is carried on in the School of Philosophy, and though open to qualified students from Teachers College, need not be described here.

GENETIC PSYCHOLOGY

Teachers College provides three courses for those who wish to study the mental development of children.

Education 9 (Child Study) presents those facts in the psychology of childhood which are of value to the teacher because they bring sympathetic insight into the conditions under which educational aims must be realized — that is, into ways and means of teaching — lend an intelligent interest to our dealings with children, and give a critical sense by which to judge the rapidly increasing literature of child study. It also affords a chance for the student to form profitable habits of observation of children. Within the limits of a two-hour course it seeks to meet the needs of the intelligent teacher.

Psychology 11 (Genetic Psychology) rehearses the facts concerning mental development in the race and in the individual, discusses the general theories which have been proposed, and describes the problems requiring solution and the methods of approaching them. It thus aims to provide the psychological data of most value to advanced students of the science of education.

Psychology 13 (Research Course in Genetic and Comparative Psychology) gives advanced students the opportunity to learn methods of original research within this field and to carry on such research with the aid of the instructor.

Education 9 (Child Study)

The general outline of the work is as follows:

I. A general account of the physical and mental life of children. First half year.

II. (*a*) The psychology of children of the kindergarten age or (*b*) the psychology of adolescence. Three weeks of second half year.

III. The theory of mental development. Three weeks of the second half year.

IV. Children as students of the school subjects. Four weeks of the second half year.

V. The critical study of typical samples of work in child study. Six weeks of the second half year.

The work under I consists of the study of certain topics by lectures and required readings, the illustration of the facts thus acquired by systematic observation of children in and out of school and by the examination of work done by children, and practice in the use of such means of testing children's senses and mental powers, etc., as should be familiar to the well-equipped teacher.

The topics studied are: —

The problems of child study and the means of exact knowledge about them.

The physical growth of children.

General and special physical defects.

Instinctive actions.

Learning (*a*) by trial and accidental success,
(*b*) by imitation,
(*c*) by ideas.

Sensations.

The influence of previous experience.

Attention.

Memory.

Imagery.

Association of ideas.

Reasoning.

The emotions.

Involuntary acts.

Voluntary or purposive acts.

Habit.
Inhibition.
Suggestion.
Motor ability.
The moral consciousness of children.
The religious consciousness of children.
Children's interests.

The matter upon these topics is presented to the class in the form of typewritten notes (containing about 40,000 words) kept upon the reference shelf in the library. This matter is discussed in the class and supplemented by quotations from original investigations and illustrations from school life.

Ten hours are devoted by each student to the work of observation, the results being presented in a written report.

Ten hours are devoted to practice in accurate methods of making and recording physical measurements, in testing vision, hearing, and color blindness, in examining the status of more complex mental processes involving attention, discrimination, memory, etc.

II. (*a*) The topics studied are: —
Mental development in the first three years of life.
The widening and refinement of experience of physical things.
The kindergarten "occupations" in the light of children's nervous immaturity.
Kindergarten games and songs in the light of the children's lack of experience.
Symbolism in young children.

II. (*b*) The topics studied are: —
The specific mental changes due to adolescence.
The general mental changes due to adolescence.
Storm and stress.
The meaning to the teacher of the facts of adolescence.

III. The topics studied are: —
Our inherited mental equipment.
The influence of the environment
(*a*) thro the formation of habits,
(*b*) thro the acquisition of ideas,
(*c*) thro the influence of special forms of training on our general abilities.

Educational applications.

IV. The topics studied are different in different years. For 1900–1901 they are: —

The attitude of children toward the study of science.

The hygienic aspect of early instruction in reading and writing.

The fitness of abstract studies (such as formal grammar or the general laws of mathematics) for young children.

Children's likes and dislikes among studies.

V. The samples taken differ from year to year. For 1900–1901 they and the questions suggested concerning them are as follows: —

CRITICAL STUDY OF LITERATURE ON CHILD STUDY

THE MOTOR ABILITIES OF CHILDREN

Pedagogical Seminary, Vol. III, pp. 9–27.

Do children have less control over their muscles than adults?

Does this imply that we should not ask them to make fine movements?

How would you improve a child's control over his muscles?

What would hurt a child's control over his muscles?

If you decided that fine movements were dangerous in the case of very young children (4–10), what changes would you make in ways of teaching reading, writing, drawing and manual training? How many of these changes would be worth while anyway? How would you tell whether certain work was injuring the child?

Can you bring any evidence from your own experience to bear on these questions? If so, what?

Where else have we seen the influence of certain movements on the child's development?

CHILDREN'S NOTIONS OF RIGHT AND WRONG AND OF PUNISHMENT

Pedagogical Seminary, Vol. III, pp. 87–96.

If we accept these accounts as roughly true, how do six-to-nine-year-old children regard punishment, as a result of wrong intentions or of certain acts? Do they think of punishment as a

corrective or as a matter of retaliation? Do they regard the letter or the spirit of laws? Why would children of this age say, "I didn't mean to"?

What general changes in their notions come with further experience? What practical precepts would you derive from this study?

Do all the children's answers represent their real feelings? Are these feelings sure signs of how they regard real punishments?

RELIGIOUS TRAINING OF CHILDREN

N. Oppenheim. *The Development of the Child.* Chapter VI.

What is Oppenheim's chief aim in this chapter?

How does he go to work to prove his point?

Do you find any flaws in his evidence?

What dangers might one incur who should follow his advice?

Pedagogical Seminary, Vol. II, pp. 442–448. "Theological Life of a California Child."

Just what does this paper prove?

Just what does it assert?

CHILDREN'S DRAWINGS

Pedagogical Seminary, Vol. IV, pp. 79–110.

Do children six to twelve years old copy a model when they draw?

How far do they try to represent what they see, "to hold up a mirror to nature"?

Just what do they try to do when they draw?

Are their drawings more like the work of artists, mechanical drawings or scientific drawings (e.g., the illustrations in a zoölogy book)? Why?

How would you teach drawing to children? Why?

Would you make any criticisms on the old way of drawing conventional patterns?

How may drawing work tend toward the general mental development of children?

CHILDREN'S INTERESTS

Recall the instinctive interests of children.

Are these alike in all children? What is their importance to teachers? How are interests acquired?

Think over your own interests and how they were caused.

What different sorts of interests are, to your mind, important for the grammar school to develop? For the high school?

Read "The Interests of Children in the Reading Work of the Elementary Schools." Clark Wissler. *Pedagogical Seminary,* Vol. V, pp. 523–540.

Is it fair to suppose that the degree to which children remember stories is a measure (*a*) of the interest aroused at the time, (*b*) of the permanent effect left by the story, (*c*) of the value of the story for them?

Are the sort of selections you yourself enjoyed most at 6, 7, 8, 9, 10 years of age the ones which you think were the best for you?

Is there any reason to suppose that when you ask a boy or girl six to fourteen years old what book he or she would select, if he could pick out any one, the answer you get may not represent a real preference?

Suppose that you were teaching a fourth-grade class, how would you go about finding out just what they liked to read, just what was good for them to read?

CHILDREN'S INTERESTS IN NATURE

Are you a successful student of science?

Do you love to study science?

Do you love animals?

Do you love plants?

Do you love rocks and rivers?

Read very critically the following references:

Pedagogical Seminary, Vol. III, pp. 61–86.

Educational Review, January, 1899, pp. 57–63.

Note any misstatements in either article.

What does the last half of *Pedagogical Seminary,* p. 76, prove about learning science?

What does *Pedagogical Seminary*, p. 77, prove?

Compare p. 75, *Pedagogical Seminary*, bottom paragraph, with p. 85, second paragraph.

Read the title of *Pedagogical Seminary* and pp. 61–86, then read p. 64, bottom paragraph, and the first half of p. 85. What have these paragraphs to do with the topic announced in the title?

What is the argument in this article?

Read with especial care *Educational Review*, p. 60 and the first half of p. 61. How far do you agree with the assertions there made? How would you find out whether they were true or not? What are various common attitudes of children toward animals, toward plants, toward the woods and country? Which among them are instinctive, unlearned? Which among them would you foster? Why?

CHILDREN'S ATTITUDE TOWARD SCHOOL LIFE

Pedagogical Seminary, Vol. III, pp. 413–418.

What does this article claim to prove? What does it prove? What suggestions do you get from it? How would you go about finding out the characteristics of the best teacher? How would you go about finding out what children esteemed most in their teachers?

What questions for study would you suggest along the line of children's attitude toward school life?

MENTAL FATIGUE IN SCHOOL CHILDREN

Psychological Review, Vol. VII, pp. 466–482 and 547–578.

Just what questions does this research try to answer?

What were the means taken?

What dangers is it necessary to guard against in any attempt to measure a person's ability to do mental work?

How did the author guard against them?

What different conclusions might be hastily drawn from the results?

Do you find anything of importance in the facts presented which the author does not bring out explicitly?

THE COMPARATIVE IMPORTANCE OF HEREDITY AND ENVIRONMENT

Read "History of Twins," by Francis Galton, in *Inquiries into Human Faculty*, pp. 216–243, and Chapter IV in Oppenheim's *The Development of the Child.*

Which of these articles seems to you the more scientific? Why?

Which is the more original?

What is the importance to education of such work as Galton's? How could a study of twins be made even more helpful to educational theories?

PSYCHOLOGY 11 (GENETIC PSYCHOLOGY, ADVANCED COURSE)

The work in Psychology 11 consists of lectures, required readings and individual reports. The general topics of the course are as follows: —

I. The problems of mental development and theories concerning them.

II. The development of intellect in the race.

III. The development of intellect in the individual.

IV. The development of the emotions, moral consciousness and will in the individual.

V. An analysis of human mental inheritance.

VI. Heredity and environment as factors in producing mental ability and efficiency.

VII. The influence of various forms of training on mental development.

VIII. Contributions from genetic psychology to the science of education.

IX. Special reports from members of the class.

Prescribed Readings in Psychology 11. (Subject to modification.)

I. Froebel: *Education of Man.* Chapters I and II.

Baldwin: *Mental Development in the Child and the Race.* Chapters I, VII–XVI.

James: *Principles of Psychology.* Vol. II, Chapters XXIV and XXVIII.

II. C. Lloyd Morgan: *Introduction to Comparative Psychology.* Chapters V, VII, X, XIV and XVI.
Thorndike: *Animal Intelligence.*
The Mental Life of the Monkeys.
III. Tracy: *Psychology of Childhood.*
Thorndike: Typewritten notes on the psychology of childhood.
IV, VII and VIII are dealt with solely by lectures.
V and VI. Galton. *Natural Inheritance.*
Hereditary Genius.
Inquiries into Human Faculty, pp. 216–243.

The subject-matter of the course is in considerable measure an original account, which goes beyond the theories in print. The readings, especially under I–IV, are for critical examination rather than actual acceptance.

Psychology 13; Research Course

The work of Psychology 13 will be arranged to suit the needs of its members. It is intended not only for students who wish to investigate problems in animal psychology or genetic psychology, but also for such as wish to make empirical studies of the phenomena of school life which cannot conveniently be carried on in the University laboratories or in other research courses. The nature of the work may be seen from the following topics studied during 1900–1901:

The mental life of the primates and its relation to human mental development.

The mental life of typical mammals.

The growth of verbal discrimination in young children.

The influence of special forms of training sense discrimination on discriminative ability in general.

The influence of special forms of training attention and observation on the general powers of attention and observation.

The value of spelling as a formal discipline, i.e., its influence on mental functions in general.

The value of Latin as a formal discipline.

The correlations between the mental functions involved in school subjects.

An inductive study of rhetorical effects with relation to methods of teaching composition.

The Relation of the Work in Child Study to that of Other Departments

The relation of the work in psychology to the administration of the Horace Mann and Experimental Schools.

It is hoped that the department may be of service to the school in two ways; first, by making any tests of the mental functions of individual children which may aid their teachers to understand and assist them, second, by making accurate determinations of the abilities or progress of classes of children in such matters as can be estimated by systematic observations.

The relation of the work in psychology to that of other departments.

The planning of courses and the decision concerning methods in the various school subjects depend partly upon the semi-intuitive wisdom of expert students and teachers of those subjects, and partly upon general aspects of human nature which can properly be studied by psychological methods. Questions about the hygienic aspect of studies and methods, about their effect upon mental functions in general, about their probable working in the light of general mental laws, occur from time to time and often remain unsettled because of the unavoidable ignorance on the part of the specialist with convenient and precise and rigorous methods of getting an answer. On the other hand, the studies of the unaided psychologist are likely to be trivial or irrelevant, because of his unavoidable ignorance of the problems which the specialist wishes solved. By personal intercourse with the heads of departments and concrete study of the special-methods courses it is hoped to make the department of psychology of assistance.

CONTRIBUTIONS FROM CHILD PSYCHOLOGY TO SPECIAL METHODS

EDITED BY EDWARD L. THORNDIKE

One of the most directly useful forms of child study is the attempt to get a rational account of the way the different school subjects influence children's minds. This sort of child study has been in progress ever since there were intelligent teachers, and we find substantial agreement on many important points. Many others, however, are in dispute, and vagaries in text-books, courses of study and methods are so frequent that it does not seem out of place to put together a few of the plain facts, to discuss some of the mooted questions, and to present for critical study samples of the studies along this line which profess to be records of actual facts, not expressions of opinion.

The Editor is indebted to the *Pedagogical Seminary*, the *American Journal of Psychology* and the *Journal of Pedagogy* for permission to reprint from copyright articles. Credit is given to author and journal in the proper places.

READING AND THE STUDY OF LITERATURE

It is easy to see that reading good literature improves the minds and morals of boys and girls, but it is hard to see just how. It is also easy to see that literary, in the sense of artistic, presentation of facts has a vastly different effect on boys and girls from that of the mere recital of the same facts or their actual experience, but nothing in human nature is harder to give an accurate account of than just what this effect is. It is easy to see that the tastes of boys and girls differ from those they will have when they grow up, and that taste differs among individual children, but it is hard to tell just what their tastes are, how they are caused and how they change.

It is self-evident that the experience of the average teacher of English literature is quite unable to secure a reliable answer to these questions. For this experience has resulted in the utmost diversity of opinion. People are teaching literature with all sorts of notions about its influence on adults, about the nature of the æsthetic emotions, especially in the young, about the tastes and interests which we find in children to start with, and about the way these change with age and culture. Because of the mental inertia which restrains all but the most strenuous souls from doing all that they think, and the general subjection to conventionality in practical procedure which characterizes most teachers, there is not such a chaos in methods of teaching literature as there is in theories about them. Yet there is enough. A list of the different books and selections read by twelve-year-olds in school to-day would amaze us all. A summary of the remarks made upon these selections by the teachers would send us from laughter to tears. Unfortunately, it cannot be said that either the cult for child study or the more systematic labor of soberer students of educational psychology has done very much better.

The literature of child study does present information about some general aspects of the mental life of young students which text-book makers and teachers have at times failed to recognize, and some definite attempts to estimate the nature of children's intellectual interests or propensities, and in particular their interests or tastes in reading. In so far as we must, willy-nilly, develop new and better interests on the basis of what we find at hand, these latter studies will, if reliable, be of considerable help in planning courses and handling material.

I shall briefly mention some of the general facts contributed by child study which seem likely to enlarge and clarify the views of teachers of English; then quote, with some comment, samples of the work on children's interests in general and reading tastes in particular; and shall, finally, discuss the matter of æsthetic appreciation from the psychological point of view.

Young children like to think and feel. They enjoy having something going on in their minds, and anything is better to them than nothing. This enjoyment of mere mental functioning may be, and has been, mistaken by teachers for æsthetic transports, scientific ardor, and religious devotion. We must remember that children may like things which we like, but for totally different

reasons, and must guard against the fallacy of the adult observer, — attributing to the child our mental attitude.

It is a general mental law that what we think or feel or do in any situation depends in great measure upon what we have thought and felt and done in the past. Children's experiences of objects and words are always factors in their appreciation of any piece of literature. What ideas and feelings do *love, envy, jealousy, ambition,* and other words describing adult passions, arouse in the ten-year-old? Certainly not those aroused in his teacher. All this teachers perhaps know, but they hardly realize the extent to which lack of experience influences not only the understanding of facts, but the appreciation of moods or literary effects. It is, in fact, a general law that works everywhere.

Children, and adults, too, are quick to assume conventional tastes, and are prone to confuse their conventional opinion that a thing is good or bad or beautiful or ugly with the real feeling of its goodness or badness. By dint of often saying that Shakspere is a great poet the student comes to think that he feels and appreciates his greatness. It is perhaps a question whether the acquisition of this pseudo-appreciation may not be a step toward the real thing. It is by no means sure that we ought always to discourage it. But it is sure that the teacher of literature should know the difference between the two and should be aware of the prevalence of this effigy of literary feeling among boys and girls, and should not be satisfied with it when real feeling can be awakened. Commonly the matter is even worse, there being not even the illusion of feeling in the scholar's mind, but only some empty phrase or so. No prophet from child study land is needed to teach us the folly of such teaching.

As a sample of the work done on the general intellectual propensities of children, I have chosen a paper by Clark Wissler, "The Interests of Children in the Reading Work of the Elementary Schools," from which I shall quote at length. The entire article may be found on pages 523–540 of Volume V of the *Pedagogical Seminary.*

THE INTERESTS OF CHILDREN IN THE READING WORK OF THE ELEMENTARY SCHOOLS

By CLARK WISSLER, Director Psychological Laboratory,
Ohio State University

Early in October, 1895, the following list of questions was sent out to a number of school superintendents in Indiana, with a request for written answers from the pupils under their charge.

1. Write the subjects of all the lessons that you remember from the Reader you used last year.

2. Which one did you like best? What was it that you liked?

3. If you were taken to a book-store and told that you might select just one book for your own, what would you take?

4. Give your *name, age* and *grade.*

Six of these superintendents had received training in the Departments of Psychology and Pedagogy in the Indiana University, the others were known to the writer personally as men capable of carrying out such directions as were given. The questions were all presented during the same week and all of the pupils in a school wrote their answers at the same hour. The pupils were ignorant of the purpose of the questions, receiving them as an ordinary lesson in composition.

Papers were received from about 2,100 children. From the teachers' reports as to the reading work of the preceding year, irregularities appeared in four different rooms, necessitating the rejection of the papers received from the pupils of the same. There remained in all 1,950 papers, 1,060 from girls and 890 from boys. The following classification presents the gradation by Readers and by the year in the course of study, the number of boys and girls in each Reader, and their ages at the time of writing these papers.

READER	YEAR IN COURSE OF STUDY	GIRLS	BOYS	AGES[1]
Second	2	236	230	8 – 9
Third	3 and 4	300	243	9 –11
Fourth	5 and 6	323	268	11–13
Fifth	7 and 8	201	149	13–15

All the schools of Indiana are required to use the State Series of Readers. This study could not have been made without such uniformity in text and course of study. While all criticisms are made with reference of this Series of Readers, they apply in a general way to all books of this class, because in range of subject matter the Indiana Series is a fair representation of American reading texts.

[1] Most of the pupils fell within the range of these ages and the variations were slight and of little significance.

I

No. 1. Write the subjects of all the lessons that you remember from the Reader you used last year.

The tabulated results of the first question are presented in diagrams, showing the per cents of girls and boys remembering the consecutive lessons in each Reader. It was found impossible to make a distinction between the two grades using one Reader because pupils would remember some lessons from the part of the book belonging to the other grade.[1] The Fifth Reader is omitted in this classification because of lack of uniformity in class work.

It will be seen from the diagrams that certain lessons were remembered by a large per cent of the pupils, others by few or none. In the following will be found a brief characterization of all the lessons remembered by five per cent or less of both sexes, together with those remembered by a large per cent.

[These diagrams I have omitted, as the data are as well understood from the text itself.]

SECOND READER

A. Lessons not recalled by any one.

PART I

(Every lesson recalled)

PART II

29. "Pretty is That Pretty Does." — Alice Cary.
A short moral lesson on duplicity.

B. Lessons recalled by not to exceed 5% of both sexes.

PART I

8. "What Does Little Birdie Say?" — Tennyson.
The life of a baby compared to a bird in the nest.

9. A boy imagines his kite as high as the stars; contradicted by a passing man and given a little information as to the correct distance. Instructive.

13. "Keep Trying" — "Drive the nail aright, boys, Hit it on the head," etc.

[1] It is well known that most children read all the attractive lessons over and over before they are formally studied.

18. A little boy attempts to tell a dog story; not interesting except as a typical child's effort.

20. "Work while you work; play while you play:
This is the way to be cheerful and gay."—M. A. Stodart.

25. Short poem treating of a rainy day in life.

26. A family of boys telling what "they will be"; one resolves to comfort and love his mother.

27. Poem—six little orphan chickens nestled at night under a feather duster.

29. A lesson on brotherly kindness pointed out in a rather extravagant story of a horse and his blind mate.

30. A fable—"The Humming-Bird and the Butterfly."

PART II

4. A rule about fretting. "All children should remember this little rule, and begin to follow it while young."

7. "Words that Deceive." "A lie that looks like the truth is the worst kind of a lie."

8. "Twinkle, twinkle, little star."

12. "Speak Gently." A well-known poem.

13. A brief account of swallows building a nest over a little boy's window.

16. An eagle flies away with a rattlesnake and is killed by it.

17. "The Drink For You." A temperance poem.

18. A brief natural history of the harvest-mouse.

19. Prose rendering of the "Leak in the Dike."

21. "Great, wide, beautiful, wonderful World." A poetical picture of the world from Lilliput Lectures.

22. Story of a girl who was so kind to the birds that they came to her for food.

28. "The Spider." Similar to No. 18 with a lesson on perseverance.

C. Lessons recalled by a great number of children.

PART I

1. A life-like sketch of some boys playing at top.

2. Story of a little girl's lamb that remembered her after a long absence.

21, 22, 23. A simple rendering of the story of King Midas, or the Golden Touch.

PART II

5, 6. A story of a little girl's visit to the inhabitants of the Arctics.

THIRD READER

A. Lessons not recalled by any one.

Part I

8, 50, 55, 56, 57. Topical reviews, picture lessons, etc.
19. Story of a rain-drop. Instructive.

Part II

7, 43, 52, 56, 62, 63. Topical reviews, etc.
6. "Song of Summer." — Mary Mapes Dodge. Short.
16. "Golden-Rod." Poetical lesson on contentment.
21. Collection of old proverbs.
24. Kind acts rewarded.
30. Similar to No. 16. Dicontented Buttercup.
32. Moral precepts in verse form.
46. Moral lesson on dreaming and doing.
49. "A Seed." Two little verses.
50. Life of a little girl saved by a bird. (An interesting story to the writer of this paper.)

B. Lessons recalled by not to exceed 5% of both sexes.

Part I

17. A short prayer in verse.
21. Moral lesson — smile and the world smiles too.
22. "Can you?" — Mary E. Folsom. Designed as an elocutionary lesson.
23. Short lesson on true courage.
27. A short allegory on human life.
31. Lesson on conduct. Verse.
32. About ants. Instructive.
33. Two pages from "Aladdin's Lamp."
34. A bird's lament for her nest. Verse.
35. Duty to the aged. Verse.
37. "The Little Brown Thrush." — Lucy Larcom.
39. Some games. Instructive.
40. "Why People Eat." — Instructive.
41. "Suppose." — Phœbe Cary.
42. Moral lesson — Look to your own faults first.
43. Stories of parrots.
45. Moral lesson on delay.
46. The Dog in the Manger. A fable.

48. Moral lesson on doing and giving.
49. The world's coöperation in making a pudding. Instructive.
52. "Spring is Coming." — Mary Howitt.
52. "The Dog and the Shadow."
53. A short bright story of two little pigs.
54. "May's Good-Night." — Mary H. Burnett.

PART II

3. Short account of how a dime is made. Instructive.
4. Play of children as seen by adults.
5. Short account of silk production. Instructive.
10. "Speak the Truth."
14. Verses on the Beautiful in Character.
15. What Live on Flowers? Instructive.
20. "Father is Coming." — Mary Howitt.
23. The Wolf in Sheep's Clothing. A fable.
25. "What God Hath Made." — W. B. O. Peabody.
26. A comparative study of teeth. Instructive.
31. About fruit. Instructive.
33. A study of the hand. Instructive.
35. A comparative study of the hand. Instructive.
42. "The Wind and the Leaves." Allegorical.
44. "Sleigh-Bells." A jingling poem.
45, 47. About metals. Instructive.
48. Anecdote of a dog.
51. Two verses about a happy girl.
53. About birds' nests. Instructive.
54. A poem — All things come from God.
58. Longfellow's Beautiful Rain in prose form to be put into verse.
61. "The Hour of Prayer." — Mrs. Hemans.

C. Lessons recalled by a great number of children.

PART I

1. A dog that cared for his blind master.
2. Hans Andersen's Five Peas in a Pod.
10, 11. Nellie Grant as the ideal little girl.
24, 25, 26. Paul Dombey. Adapted from Dickens.

PART II

1. Biographical sketch of Washington.
11. Story of a dog saving a child from drowning.
17. A dog saving a boy lost in the snow.
40. "Piccola." — Celia Laighton Thaxter.

FOURTH READER

A. Lessons not recalled by any one.

Part I

14, 20, 34, 37, 39, 43, 49, 56, 57. Topical Reviews, etc.
4. About the hand. Instructive.
10. Fables — Farmer and the Stork, The Crow and the Pitcher.
21. "The Voice of Spring." — Mrs. Hemans.
22. "The Grave." — James Montgomery.
31. A few lines from Byron. Heroic.
38. Fable — The Wind and the Snow.
45. "Birds in Summer." — Mary Howitt.
46. A stanza of four lines. Moral.
51. Classification of the teeth. Instructive.
53. "Kitty." — Miriam Douglas.
54. Riddles and humorous plays upon words.
55. Use of metals. Very short and instructive.

Part II

44, 51, 52. Topical Reviews, etc.
4. Short abstract discussion of silent reading.
19. The Romans. Short extract from E. A. Freeman
20. Short account of the Sahara. Difficult.
31. Allegorical story of a leaf. Human life.
34. "The Creation." — Addison.
36. A story with a moral.
38. Some of Poor Richard's Sayings.
39. A one-page story of heroism, from Carlyle.
41. A part of the 106th Psalm.
45. A study in words from Webster's Spelling Book.
47. Extracts from the Bible.
48. The Christmas Dance, from Dickens's Christmas Carol.

B. Lessons recalled by not to exceed 5% of both sexes.

Part I

11. A few lines from "How Sleep the Brave."
24. A few simple rules of health.
25. A model composition with suggestions.
42. "Wanted — A Boy." A moral lesson.

PART II

10. About the atmosphere. Difficult and instructive.
17. Monkeys making a bridge. Instructive.
21. "Babie Bell." — T. B. Aldrich.
27. Biographical sketch of Adams and Jefferson.
32. "Young Lochinvar." — Scott.
35. Biographical sketch of Andrew Jackson.
40. "Burial of Sir John Moore." — Wolfe.

C. Lessons recalled by a great number of children.

PART I

1. Sketch of Franklin, with his own story of the whistle.
2. A man telling a king the story of the locusts. An odd story.
7. Preparing for Christmas. A selection from "Little Women."
9. "Ellen More." — Mary Howitt.
13. "The Old Oaken Bucket."
15, 16, 17, 18. The Ugly Duckling, from Hans Andersen.
26, 27. The Life and Anecdotes of Columbus.
28. "The Day is Done." — Longfellow.
29, 30. Story of a dog that wandered off into the world and after a long time saved the life of a child.

PART II

1. Sketch of Daniel Webster.
11. "The Gemsé Fawn." Pretty story in verse.
12. Mr. Squeers and the Boarding School. — Dickens.
14, 15, 16. The Battle of Bunker Hill.
18. "Flowers the Stars of Earth." — Longfellow.
22. "We are Seven." — Wordsworth.
25. Marshal Macdonald rescuing a little drummer boy carried down by an Alpine avalanche.
28. "Lucy Gray." — Wordsworth.
43. "The Little Match Girl." — Hans Andersen.
50. An Arabian horse saves his wounded master by taking the man's belt in his teeth and bearing him home.

SUMMARY

	Second Reader	Third Reader	Fourth Reader
Per cent of total number of lessons not recalled	1	17	33
Per cent of lessons recalled by not to exceed 5 per cent.	34	40	11
Per cent of lessons recalled by a great number of children	10	9	23
Per cent of lessons recalled by an intermediate number	55	34	33

This characterization of lessons has been presented that the reader might see for himself the number and the nature of the lessons falling under the principal divisions. Space does not permit the discussion of details or a presentation of a characterization of all the lessons of the various Readers. The foregoing gives a rough gradation of lessons from the impressive to the indifferent. Bearing in mind that this study is based upon the returns of about 500 children to each Reader, it is a very severe criticism to say that no one remembered certain lessons. From this point of view, about 16% of the aggregate number of lessons in the three Readers represents time wasted. Little more can be said for the 28% named by not to exceed 5% of the pupils. That is to say that 44% of the number of lessons in the Indiana Series could have been omitted without loss to the pupils.

An examination of the diagrams and the foregoing classification leads to the following conclusions:

The first lesson of the different Readers is well remembered, also the continued lesson, or long story.

All of the lessons remembered to any great extent, except a few remembered for their oddities, are in terms of experience the child can realize in himself.

The lessons remembered most are especially natural, or life-like.

The curves of the sexes are remarkable in agreement, that of one appearing a duplicate of the other. The principal difference is in the number of lessons remembered, girls remembering more than boys.

The lessons not remembered by any child are too short to excite interest or do not treat of things a child can appreciate.

The mere instructive lesson; the moral and its setting; abstract poems concerning duty, happiness, love of nature, etc., make up the bulk of those remembered by 5%, or less.

II

No. 2. Which one did you like best? What was it that you liked?

The range of preference was great. In very few cases did more than 10% of the pupils prefer a given lesson. The extreme was for the first lesson of the Second Reader, which was preferred by 21%.

It seemed difficult for many pupils to decide which of the lessons they preferred; e.g., many said they "liked them all (all they remembered), but thought they liked best, etc." But when it came to saying what it was they liked about a lesson no hesitation was apparent. Because of the lack of decision in the former, the writer is inclined to believe that the number remembering a lesson is a better indication of what impressed the children than the number preferring the same.

The following general classification (Table I) of the lessons into poetical and prose, together with the preferences for the same, shows the total number of choices falling upon poetical selections to be large, notwithstanding that the number of prose selections in the Readers is more

than twice that of poetry. A remarkable increase in the preference for poetry appears in the Fifth Grade where such poems as Evangeline, Thanatopsis, Snow-Bound, etc., were read. In every case the girls lead in the preference for poetry.

TABLE I

Distribution of preferences as to Poetry and Prose

	Number of Selections	Per Cent. of Children Preferring	
		Girls	Boys
Second Reader			
Poetry	18	14	8
Prose	47	86	92
Third Reader			
Poetry	40	22	15
Prose	80	78	85
Fourth Reader			
Poetry	31	33	27
Prose	78	67	73
Fifth Reader			
Poetry	Work	81	66
Prose	Irregular	19	34
Total			
Poetry		37	29
Prose		63	71

Some facts of general significance appear in the table. There is a growth of interest in the poetical coincident with age, beginning with a low per cent and ending with a high per cent. It is probable that young children are interested only in the rhythm of verse as found in rhymes of the Mother Goose type, and that real poetry receives little recognition before the adolescent period. The general preference for poetry in the Grammar Grades (Fifth Reader) is, at least, a vindication of the right of such poems as Evangeline and Thanatopsis to a place in the Seventh and Eighth Years of the Course of Study. The poems in the Second and Third Readers are chiefly those of sentiment and thought, but the preferences fall upon those in which rhythm is prominent; as

"Two little kittens, one stormy night,
Began to quarrel, and then to fight." Popular, in the Second Reader.

"Now, such a story I never heard!
There was a little shivering bird!" Popular, in the Third Reader.

In the Fourth Reader a transition is shown in preference for "We are Seven," and "Old Oaken Bucket," with scattering preferences for

more weighty verses. Then in the Fifth Reader are many preferences for "Rainy Day," "Thanatopsis," "Evangeline," etc. In general, the interest in verse begins in childhood with the rhythm and passes over gradually into sentiment and thought in adolescence. The makers of our textbooks have not taken this into account.

Since the subject matter of a selection does not depend upon the form, a close view of the children's interests necessitates a classification of the lessons with regard to general theme. Table II presents the relative preferences for selections classed under the given themes.

TABLE II

Classification of lessons according to theme, showing preferences for each class

	2nd R.		3rd R.		4th R.		5th R.		TOTAL	
	G. %	B. %	G. %	B. %	G. %	B. %	G. %	B. %	G. %	B. %
Fables	1	1	3	5	0	1	0	0	1	2
Heroism	4	3	0	0	10	24	4	7	5	8
Biography	0	0	12	11	7	6	2	4	5	5
Stories of animals	19	21	12	14	14	11	0	0	12	12
Adventure	0	0	0	0	0	2	0	1	0	1
Information	2	1	2	4	2	2	3	1	2	2
Moral Precepts	4	3	9	8	0	2	17	18	7	8
Stories of Daily Life	39	41	28	24	32	20	35	35	34	30
Description	4	3	4	0	3	3	33	30	11	9
Unclassified[1]	27	27	30	34	32	29	6	4	23	23

[These figures may be misleading, for we are not told how many of each sort of stories the readers in question contained. For instance, if in the second reader 50% of the stories were of the "*moral precept*" order and only 5% of the "*daily life*" order, the fact that only 4 and 3% of the former were preferred to 39 and 41% of the latter would be all the more impressive, while if there were only 5% of "moral precept" stories in the reader and 50% of "daily life" stories, the percentages of preferences would have much less weight. For children will be more likely to find a story to prefer in ten of a certain sort than in one, and in so far as their

[1] A large number of pupils preferred selections from other books, and as we had no means of knowing where to look for these preferences, they were placed with the few lessons of the Readers that failed to fall under the other heads. The schools from which these papers were received have in the school libraries several sets of Readers used as supplementary texts.

stated preferences were due to chance they would be proportional to the percentages of the different kinds of stories in the readers.

For this reason also the estimates of the change in interests through the grades may be misleading, for if the later readers did not have the same proportion of the different types of selections as the earlier the dice would be weighted and the changes observed might be in part due to the different material offered for interest to choose from.]

In this connection some idea of the reasons given for these preferences is necessary. (See No. 2 of the syllabus.) After reading a large number of answers to this part of the question, the following empirical classification was determined upon.

Reasons for preferring:

1. No reason given.
2. "Interesting"—only such as employed this word, and it may mean different things in different cases.
3. "Beautiful," "nice," "pretty."
4. All answers indicating the desire for knowledge [as] the ruling factor in the choice.
5. All basing the preference upon the acquisition of a moral principle.
6. All in which the child found pleasure in his experiences reproduced in the lesson; i.e., true to life.
7. All indicating the child's pleasure in heroic action.
8. Miscellaneous and oddities.

For results see Table III.

TABLE III

Classified as to the basis of the preference

	2nd R.		3rd R.		4th R.		5th R.		Total	
	G. %	B. %	G. %	B. %	G. %	B. %	G. %	B. %	G. %	B. %
1. None	20	17	8	9	6	6	5	12	10	11
2. "Interesting"	0	1	2	2	3	4	4	10	2	3
3. Beautiful	7	7	5	3	2	4	3	0	4	4
4. Information	7	9	9	11	6	10	9	10	8	10
5. Moral lessons	13	13	17	14	42	30	26	25	26	20
6. True to life	39	33	27	25	21	18	22	18	27	24
7. Heroic	4	7	17	20	11	24	5	12	10	16
8. Unclassified	10	13	15	16	9	4	26	13	13	12

From this we find that the children preferred most lessons that suggested a moral truth, a bit of real life or heroic action. The boys lead in

the latter. A gradual decline of interest in the life-like is observed with a corresponding gain in the moral and the heroic. In the Second Reader nearly 40% were attracted by the life-like, while in the Fifth about 20%. It is probable that young children are content with the images called up by a selection, while older heads look for hidden significance and abstract principle. To the child it is enough that he loves a thing "because it did" a certain way, but the youth scorns such a makeshift, basing his admiration upon the presence of practical suggestion or laudable personal characteristic. Yet even in the case of the youth, are we sure that he has not employed his reason for the concealment of his original simplicity?

No marked sex difference appears either in preference or in basis of preference, and the uniformity of per cents in Tables II and III shows that in this respect girls and boys stand upon equal footing. The nicety of balance between the per cents for the sexes gives peculiar force to this result.

Table III is indicative of the interests of the children. Its results differ from the classification by themes because the different phases of the lesson appeal to different individuals. In general, it represents what the child saw in the lesson. Table II gives about 32% of the preferences to Stories of Life, 12% to Stories of Animals, 7½% to Moral Precepts, 1% to Fables, 6% to Heroism, and 2% to the instructive. Table III gives reasons for preference about 25% as life-like, 23% as Moral Lessons, 13% as Heroic, and 9% as instructive. From this it appears that the fable received little consideration, and that even the moral lesson without the formal statement in conclusion, but bearing upon it the marks of a moral purpose, received less attention than the simple story whose moral force was felt and appreciated. It is further observed that the heroic in action is given more consideration than the formal hero, and that lessons designed to be instructive receive little regard from those whose preferences lean toward knowledge. The charge is often made that children have no regard for moral ideas, no feeling for the divinity of right action, and no love for knowledge; these results show that children do appreciate such things when presented in terms of their own experience. Take out of their text-books the sermon, the philosophical fable and the cold stiff hero, and paint into them the good, the true and the heroic in colors from life.

III

No. 3. If you were taken to a book-store and told that you might select just one book for your own, what would you take?

The choice of the children fell upon 246 different books. Twelve of the leading books are given here with the per cents of the girls and boys choosing the same.[1]

[1] For a similar list see Report on Child Reading, by H. C. Henderson. Report of the Department [of] Public Instruction of the State of New York, 1897.

TITLE	GIRLS	BOYS
Longfellow's Poems	11%	8%
Robinson Crusoe	7	12
"A History"	5	9
Bible	5	4
Seven Little Sisters	4	3
"A Story Book"	3	5
Black Beauty	2	3
Uncle Tom's Cabin	2	2
Little Lord Fauntleroy	3	1
Man of the House	2	2
Little Women	2	0
George Washington	2	3

None of these books can be said to be popular, unless it be Longfellow. While of the total number of pupils only about 10% chose this book, the number of girls in the Fourth and Fifth Readers choosing the same is about 14% and 25% respectively. Deducting the number of pupils in the Second Reader, since they had little opportunity of becoming acquainted with Longfellow's writing, we find that 14% of the girls and 10% of the boys chose a volume of his poems.[1]

In Table IV is shown the distribution of choices among the different classes of books chosen, according to text-book gradation.

TABLE IV

	Reader	II	III	IV	V	Totals	
1. Fiction	Girls	66%	66%	42%	36%	53%	53%
	Boys	74	54	43	32	53	
2. Poetry	Girls	2	10	24	44	18	14.5
	Boys	1	9	13	27	11	
3. Biography	Girls	3	5	5	6	5	5.5
	Boys	2	6	9	11	6	
4. Travel	Girls	0	0	0	0	0	0.5
	Boys	0	0	1	5	1	
5. History	Girls	0	4	10	5	5	7.5
	Boys	1	9	19	10	10	
6. Religion	Girls	8	6	8	1	6	5.0
	Boys	5	4	4	4	4	
7. Science	Girls	1	2	0	1	0	2.0
	Boys	2	4	3	2	3	
8. Humor	Girls	0	0	0	1	0	0.5
	Boys	1	1	0	2	1	
9. Miscellaneous and Unintelligible	Girls	20	6	11	6	10	10.0
	Boys	14	14	8	7	10	

[1] In a Study in Moral Education, by J. R. Street, *Pedagogical Seminary*, July, 1897, p. 28, Longfellow is shown to be the most popular author among young people.

From this it appears that 53% of the children chose fiction, 15% poetry, 7% historical books, 6% biography and 5% religious books. This indicates a great interest in the story and the novel. The poetical works chosen were the poems of Longfellow, Bryant, Riley, Lowell, Whittier, Holmes, and the Cary sisters.

Sex differences are found here. The boys possessed greater individuality of choice. Though the number of boys (890) was less than that of girls (1060), the choices of the former fell upon 175 different books, the latter upon 157. The range of choice is represented by the average number of pupils choosing each book. The averages for girls were: Second Reader — 4.2+, Third Reader — 4.8+, Fourth Reader — 3.7+, and Fifth Reader — 4.2+: for boys 4.8+, 2.9+, 2.5+, and 2.6+. In both the maximum range was reached in the Fourth Reader.

[The sex differences and the changes due to age which Table IV manifests are summed up by Mr. Wissler as follows:]

1. *Fiction.* That there is little difference in the sexes; both showing a gradual decline with the advancement of age.
2. *Poetry.* That the interest of both sexes increases rapidly with age, but that the girls lead with a constant gain.
3. *Biography.* That the boys lead.
4. *Travel.* That books of this kind did not interest either sex.
5. *History.* That the boys lead, but the girls follow in parallel; the maximum is reached in the Fourth Reader.
6. *Religious Books.* That the interest is approximately constant.
7. *Science.* That the general interest is small, the boys leading.
8. *Humor.* That the interest is very small. Humor is the product of the mature, and the highest types are found among the most mentally acute. The appreciation of it begins about the time of adolescence.

The curves show that the child comes to the Second Reader with a great interest in the story, while interests in other kinds of writing have barely taken form. The broadening influence of the school makes him conscious of other things, especially of poetry, where he finds things that cease to be fiction when he feels them true of himself. In the Fifth Reader poetry and fiction become rivals, the former favored by girls, the latter by boys; this results in a decline of interest in other literature.

The curves of the sexes for biography, history and poetry have the same general direction and suggest a greater susceptibility of girls to school influences. The school turns its forces upon boy and girl alike, but meets greater resistance in one or the other. At the start the sexes have much in common, but growth brings divergence.

A general sex difference appears from an examination of the books peculiar to the choice of each. Both lists contain a large and approximately equal per cent of fiction, but this fiction differs in kind. Among the works of fiction chosen by girls are many books that portray the home life and every-day thought and emotion. The love story interests the older girls. Many boys preferred fiction reciting the exploits of the

adventurer in the garb of the scout, the explorer, the soldier, or the "young man making his way in the world." The books not belonging to the class of fiction are of a practical nature, but show the same differences; the girls choosing more of those relating to deportment and social and domestic training, while the boys led in those relating to industrial or professional lines. In general it seems that the girls have greater interests in the field of action where affection and kindness are striving for the noble and the true, the boys in that field of action where strength, courage and honesty of purpose struggle against the more material environment.

[In a somewhat similar study Miss Clara Vostrovsky discusses the sex differences in taste, on the basis of the statements of school children as to the last book they took from the library, and why they liked it, in case they did. She says:]

Not only do more girls than boys rely on a mere feeling of niceness in regard to their reading, but more, too, rely on the recommendations of their friends. The greater independence on the boys' part goes with the more definite reasons for taking out books, which is confirmed by the greater percentage under "substance and school." The inference that boys are guided more by reason, girls more by sentiment, in their reading, is strengthened by the fact that the results in Juvenile, Fiction, and General Literature corroborate one another in regard to this.

* * * * * * * *

Certain other very marked differences between the sexes come out in this study, particularly in a classification of the children's tastes as definitely mentioned by themselves, especially in regard to the juvenile story books which they read, since it was found that in drawing these the children consulted their real interests most often. In this classification 52% of the girls say that they took the story because it was about children (generally about girls), while this is true of only 12% of the boys. Only 24% of the girls chose the book because it was exciting, while 76% of the boys state their delight in the venturesome. This great difference is made still greater by the fact that the exciting stories mentioned by the girls are very quiet compared to those mentioned by the boys, "The Young Lieutenant," by Adams, and "Robinson Crusoe" being perhaps the most exciting. The boys' tastes in general are well illustrated by a boy of twelve, who states that he took "The Moose Hunters" because he liked to read "about the wilderness of the world";[1] while the following sentiment by a girl of fourteen is shared by a large number of others, "I like 'Quinnebasset Girls,'" she says, "because it tells all about the thoughts and feelings of girls."

[1] It is probably due to a recognition of this that certain boys' magazines, like Harper's "Round Table," which devote themselves largely to stories of adventure, have achieved so great a popularity.

TABLE I

Showing Children's Tastes, as Definitely Mentioned by Themselves

	Boys Per Cent	Girls Per Cent
Because of children . . .	12	52
Because of adventures, etc. .	76	24
Because funny	6	12
Because of miscellaneous reasons	6	12

Since the name of a book presumably plays some part, however unconsciously, in deciding whether or not it will prove interesting, the juvenile books were again classified to see whether the titles in themselves bore out, in the main, the children's statements in regard to their preferences. 71% of the girls' books had names suggestive of children, while this was true only of 21% of the boys' books. While some of those mentioned by the girls were in regard to boys alone, not one given by the boys was merely in regard to girls. Are girls, then, more interested in their brothers than boys are interested in their sisters? Only 10% of the names of the girls' books indicated adventures, against 50 per cent of the boys. which had such suggestive titles as "The Young Defenders," "A Night in the Swamp," etc.

TABLE J

In Regard to Titles of Last Book

	Boys Per Cent	Girls Per Cent
Of children	21	71
Of adventures, etc. . . .	50	10
Of fairy-land	6	6
Miscellaneous	23	13

All this taken together, seems to indicate [in] girls more domestic and [in] boys more adventuresome tastes. It is in line with what Max. Pemberton, who has himself written books for boys and edited a boys' paper, has to say: "For style a boy cares nothing; he reads Stevenson for the story. He must have incident, excitement, — a hero."

When we come to the authors most often mentioned by boys and girls, we meet again the wide dissimilarity in their preferences. Girls mention 79 different authors, boys 65. Only 17 are mentioned by both, and of these, Louisa Alcott and Horatio Alger are apparently the only ones who enjoy at all anything like equal favor.

Alcott, by far, stands first in the girls' list; Sophie May comes next, followed by Martha Finley, H. Alger, Minnie Paull, Frances H. Burnett, in the order given, — almost all women writers, it will be seen.

W. T. Adams (Oliver Optic) is the favorite with boys, being named

almost twice as often as his successor, Henty. Then come Edward S. Ellis, Horatio Alger, followed by Harry Castleman, J. T. Trowbridge, and L. A. Alcott, — in this case almost all men writers.

In fiction, taking the entire number of books mentioned, it is interesting to find that more standard works were drawn by boys than by girls. — *Pedagogical Seminary,* Vol. VI, pp. 532-534.

THE ÆSTHETIC EMOTIONS

If we are to know what we are about when we are teaching English literature to boys and girls, we must get some rational account of what the æsthetic emotions are and what they do to us. Knowledge abdicates and opinion reigns if we ask just what the so-called æsthetic effects are and what difference they make in one's general character. This is a psychological question, to be settled by psychological methods, and it is a shame that, at least since Aristotle, the best work and the bulk of the work should have been done by literary men who had the data but not the means of handling them or of understanding their significance. The equipment fit to solve the question is that of a gifted person, acquainted with psychology, and possessed of psychological insight, who has studied extensively the effects of literature on people, particularly on children, for the nature and functions of the æsthetic emotions will be clear only in the light of their origin and development. No such person has appeared with the answer, and we must be content with clearing a passage for him in so far as present data allow.

This is no occasion for a treatise on the æsthetic emotions from the standpoint of genetic psychology, and no such treatise will be attempted. Let us simply try to see clearly what facts we can state as a supplement to the existing material on æsthetics and literary criticism, which may assist the intelligent teacher to an insight into what happens when students are led to read literature ostensibly for æsthetic enjoyment, for fun.

First of all, with any given piece of literature, all sorts of different things happen in different people. Not only do many of them fail to get the æsthetic pleasure intended, but in those who do it takes many forms. Of those who do not, some feel in its place *bona fide* feelings, actual attitudes toward the real world, real, not æsthetic, emotions. These may be to them de-

sirable or the reverse. Of those who do, some feel an enjoyment of the technical skill with which the writer has secured his effect; they enjoy the poem as the foot-ball expert enjoys watching a game, not caring which side advances, unmoved by the zeal of combat, influenced only by the skill of the plays, the adroitness of the generalship, the technical beauty of the way things are done. Some feel the sensory delights of rhythm or melody; they enjoy the poem as the artist might enjoy the proportions of the foot-ball player, the grace and ease of his movements (rare enough in a foot-ball player). The majority enjoy what is poorly called, for lack of a better word, the *suggestiveness* of the poem, the mood it arouses, the feelings of joy or sadness or pity or faith, that are not real joy or sadness, but, somehow, are sweet. "It means so much, it made me feel the thing," they say. These are like the spectators who enjoy a foot-ball game because men may, and do, get hurt, because they feel, yet without results to their own profit or loss, the ambition for victory, the pluck and catastrophe and recovery. There are, of course, all sorts of combinations of these three types.

It is obvious that what we would at the first blush call "æsthetic appreciation" turns out to be now one thing, now another, now a complex. Indeed, many people, failing to experience any of these three mental conditions, take definite ideas or ordinary emotional feelings to be the "æsthetic emotions" of which they read. Many a one there is who reads his Browning in dead earnest as a sort of philosophy, commentary on human nature and moral guide, happy to get great ideas and feel new hatred of this and love of that, and thinks that he gets all there is in the poetry for any one, and wonders how intelligent people can endure Keats. From this ambiguity of the words "æsthetic appreciation" and "æsthetic emotions" has arisen much confusion. Let us therefore use the terms ideas, real emotions, enjoyment of workmanship, sensory pleasures, and pseudo-emotions to cover the main facts of the mental conditions aroused by literature. Of these terms, we may further define real and pseudo-emotions. Let us mean by real emotions such feelings as lead us to acts appropriate to the situation if real. The countryman at the theatre who wants to climb on the stage and knock down the villain in the play offers an example. Let us mean by pseudo-emotions such feelings as do not. If we enjoy reading or

seeing the last act of "Othello," it is because our emotions are not such as lead us to shriek with horror or turn away our eyes from the awful sight. We may now secure some profit from the analysis and natural history of these various effects.

The ordinary laws of human nature account for the nature of the ideas aroused by works of art, and we have seen that in practice the service of literature in presenting ideas and arousing ideals has been recognized.

The production of real emotions is of two sorts. The poem or story may arouse the emotion which the facts or events portrayed would, if real, or it may arouse some different emotion. The example already given is of the first sort. The arousal of a high flood of joyous excitement by the description of a double duel in the dark is of the second sort. The practical problem of when and where it is desirable to use literature to induce real emotions is not hard. We may merely repeat Professor James's warning against exciting them without providing some useful outlet in conduct and insisting that it be taken then or later. We may also suggest that the rational man will regulate his emotional attitude toward the real world by the facts of that world itself rather than by second-hand and often distorted pictures of them, and that there is some danger in forever wheedling people into being wise or good or happy. However, as things go, most of us will probably have to be wheedled.

The enjoyment of workmanship is so rare among young students that nothing need here be said of it.

The sensory pleasures are a far less important part of appreciation in the case of literature than in the case of music, painting or sculpture. Either because we are born with organizations which like certain combinations of sounds, lengths, stresses and pauses, or because these combinations have gone with other desirable things, we come to like certain rhythms, etc. The explanation of those due to our organization will undoubtedly turn out a purely physiological one. The explanation of the second sort is a matter of association.

The sensory pleasures appear early in the child's love of rhythm, and are moulded by precepts to some extent, still more by example. The æsthetic education of children in the purely sensory appreciation of literature can thus begin early.

What, now, of the chief problem in the æsthetics of litera-

ture, the nature of these pseudo-emotions? What is the æsthetic pity that is not real pity, the sympathy with the hero which does not produce real pain or real tendencies to help him? They are not the real emotions in weaker intensity. On the contrary, they may be stronger. They are qualitatively different. This difference is not, as has been suggested by some writers, the absence of a personal element; we do not feel real emotions with a personal warmth and intimacy and æsthetic, or, to use our word, pseudo-emotions, with the calm of an indifferent spectator.

The qualitative differences that one finds by observing himself and questioning other people are that the painful quality of many real emotions is absent from their pseudo-equivalents, — we like to feel pseudo-sorrow. The pseudo-emotions are less permanent and, therefore, more easily modifiable. The tendency to fatigue and prostration, which is a result of real emotions, is largely absent in the case of the pseudo-emotions. A man tired from the excitement of a fit of rage might go to see "Othello" to get rested.

If we now become genetic psychologists for a moment, we may find the key to the real nature and function of these emotions. For they evidently grow out of the imaginative play of children. Children systematically and habitually turn the objects and events of the natural world into means for keeping their mental life going. They themselves play the rôles and make their own actions help to arouse the feelings they so enjoy. They learn readily, and in easily ascertainable ways, to so manipulate their environment as to get such feelings out of it as do not bring painful consequences or the need of hateful inhibition and effort. A witness to the connection between the later pseudo-emotions due to literature and the earlier pseudo-emotions due to play is found in the frequent tendency of young readers to put themselves in the place of some one of the personages in a story. The boy makes the hero's words his words, the hero's acts his acts, and lets the rest of the book be a stage for his adventures, and thus assimilates the new form of mental play to the old form in which he himself did actually run and fight and conquer. Were I to rename the process of enjoying literature, I should call it "contemplative play." Were I asked to tell the date of appearance of the æsthetic or pseudo-emotions, I should answer that when the baby begins to act for the sake of gaining feelings

other than those connected with such purely physical matters as food, warmth, exercise and protection, then and there he starts on the æsthetic highway. When he begins to use words as a means of gaining such feelings, his career as an appreciator of literature has begun, and from then on a continuous development may be traced.

Children like to feel, we said in another connection, just as they like to move. To have things going on in their minds is *per se* desirable. The desirability increases in proportion as they can exclude the particular elements of feeling which cause discomfort. Chief of these are certain sensations and emotions which nature provides as warning signs against dangerous conditions and the feeling of effort or inhibition which is present when we keep some thought or feeling down. In their play, I said a moment ago, children so manipulate their environment as to get such feelings out of it as do not bring painful consequences or the need of hateful inhibition and effort. The feelings brought by play then differ from those of serious life by virtue of what they are not, by virtue of the pain and effort that they do not arouse. Here we have our fundamental distinction between the pseudo and the real emotions. The former differ from the latter by virtue of what they are not, by being responses to stimuli which the wisdom of long literary effort has devised to arouse feelings minus certain undesirable elements. Just as the child finds the acts and ideas that excite without frightening or stimulate without effort, so the tribe of writers have found means of presentation which filter off the joy of conflict from its tremors, the sweet of sympathy from the bitter, the thrills of ambition from its strife and worry, the zest of interest from its strain and effort.

From the nature and genesis of these pseudo-emotions we may now hope to learn their function. Except by special dispensation, they do not serve to purify the mind of their real parallels. There is no reason why they should, and no evidence that they do. Nor do they serve to predispose the mind to their real parallels. It does not make children feel real lonesomeness to read *Robinson Crusoe,* nor real bloodthirstiness to read *The Last of the Mohicans.* We know well enough how the quietest people can revel in the pages of romance. When a child's emotional make-up is changed by the books he reads, it is the real emotions, or, more often still, the ideas aroused, that do the work.

The function of the pseudo-emotions is simply to give innocent pleasure and to be symptoms that the mind is at least healthy enough to enjoy unimpeded action. With our pseudo-emotions from novels and dramas we play at love or war as our children play at keeping store or hunting bears.

Play on, children of all ages, says the wise man. Only do not imagine that you are saving your souls or remodelling your minds by the game. Play on, you who are champions, professionals, who turn play to a trade and live by your skill at it, who write essays telling how you feel as you play so that others may emulate you. Play on, but do not despise the workers in this world.

HAND WORK

Numerous problems arise in connection with hand work in the mind of any one who is interested in the mental processes by which children learn and in the results on their make-up of different sorts of training.

Just how is manual skill acquired? Just what laws govern the growth of accurate and controlled movements? Are habits of our hands and eyes more permanent than habits of thought? Just what are the inborn tendencies that make children zealous in constructive hand work? Just why do they learn more about a square by cutting out a bad one themselves than by seeing a good one that some one else has made? Just what conditions of physical and mental growth limit the kind and quality of movements children can make, and in what ways? What is the reaction of hand work upon knowledge and self-control and attention and all the mental habits? These and other questions at once attract the scientific student of children.

With the limited time at our disposal, it seems wise to present data on only the last two questions, since they are at present subjects of discussion by teachers of manual training. What, then, has psychological investigation to say about the development of motor ability in children and the contributions of hand work to the intellectual and moral make-up of children? Let us answer the last question first.

The Reaction of Hand Work on the Mind

Let us limit our question from the start to the direct contribution of a motor act to intellect and character, leaving one side the possible indirect influence due to the acquisition of technical skill, the preparation for a trade or profession, the relief from the harm that might result from idleness, etc. What we are talking about will become clear enough as we progress.

When a boy drives a nail or draws a straight line or bends a bit of iron to a right angle, he has certain feelings of the situation involved, of the position of his hands, the nature of the material he is working on, of the tool he is working with; as he works, new sensations come from the tools and material and from his own movements. As a medical student learns about the body he is dissecting by dissecting it, so the hand worker learns about the stuff he works on. He acquires knowledge in psychologically the same way as the observer of animals or the experimenter in a chemical laboratory. The difference is in the kind of knowledge, his being about certain material substances, tools, and movements of his own body. There is, however, another possible difference. The student of chemistry or biology may, the student of history or literature often does, satisfy his teachers with only vague, verbal, moribund acquaintance with the facts in question, while the hand worker cannot satisfy his teachers unless he has acquired real, living feelings of things which are operative in directing his movements aright. He is more likely to gain real knowledge.

On the other hand, the knowledge gained by hand work is likely to be narrow and trivial. The hardness of woods or metals, the capacities of tools, the feelings of one's fingers in drawing, — these are not the sort of facts whose possession gives insight into men and things. Their value is not for general intercourse, but for certain special dealings with one small part of nature.

But our boy drawing the straight line may acquire, besides this direct information about material, tools and his own movements, secondary ideas about his procedure. He may get a notion of accuracy, of the possibility of doing a thing precisely, or of thoroughness, of doing everything that should be done in a certain task. He may learn that to do a thing well you have to be patient and cautious and attentive and to know beforehand what you are trying to do. Of course, there is a chance to learn all such lessons in connection with a page of the spelling-book or an example in arithmetic or a game of marbles. But it is easy to avoid all or some of them in most studies, whereas the teachers of hand work tell us that it is hard to do one of their tasks satisfactorily without learning them. It would, at least, seem harder than in the other studies.

The mistake must not be made, however, of supposing that

there is any necessity or even high probability that these most valuable general ideas will come from acts of manual skill. But there is an opportunity for them which teachers of hand work may improve. As to the claim that hand work excels other studies in this particular, there is little evidence. On *a priori* grounds one would perhaps surmise that for young children it did. On the other hand, one would perhaps surmise that the idea of industry or accuracy or order gained from hand work would be less likely to transfer itself to other fields and be operative in other connections than would the same idea gained from work in science.

The scholar who takes a course in manual training under wise guidance acquires from the work not only the special information and, possibly, the general ideas so far described, but also a lot of habits, perseverance, orderliness, muscular control, etc. There has been a tendency to confuse the habit, say of perseverance, in particular sorts of tasks, which does accrue as a result of hand work, and the habit *in general,* which neither manual training nor any other school study does much to advance. We do not reform the mental constitution and moral habits of children by courses in hand work or in anything else, and it is time to stop making believe that we do. The habits acquired do not extend far beyond the particular sorts of circumstances in which they were formed. The same is true of the powers, such as adroitness, executive ability, artistic appreciation, which manual work may develop. They are narrowly confined to the particular sort of data with which the student has worked. Appreciation of design, yes perhaps, but appreciation of poetry or music, no!

The scholar's experience with hand work may further provide him permanent interests of a desirable sort, interests in construction, design, technical skill, the lives and conditions of artisans and manual workers of all sorts.

We have said nothing of any "energizing of the brain centres," "strengthening of the will," or "beneficial reaction of the body on the mind." We have not invoked as the triumph of participation in manual work any mysterious transformations of personality due to the connected training of body and mind, movements and thought. And for the very good reason that all such talk would be rhetoric, not science. What happens to the person who performs intelligently an act of manual skill is a

simple matter summed up in the words harmless occupation, technical skill, knowledge of material, movements and tools, general ideas and ideals, habits, powers, and interests. Nothing more wonderful happens to him than when he speaks or writes or reads or plays. Comprehension of the effects of hand work upon the worker has been hindered by the failure to see that in their general nature and influence movements of the hands in the manual training class work were nowise different from movements of the eyes, throat muscles and legs, from movements of the hands in writing or playing the piano or juggling. The physical and mental processes involved in a piece of hand work are in their general constitution precisely similar to those involved in reading, writing or arithmetic. In all cases there is control of movements by feelings, and acquisition of feelings through the movements. In all, movements occur as expressions of the person's mind and as agents which provide new experiences for it. No generally different sort of result will come from one that doesn't from another. The differences will be in the particular skill, particular knowledge, particular habits, etc. In the olden time it was fashionable to adore those forms of life where the body was little in evidence. Now we are zealous to have as obvious bodily expression as we can. But the bodily expression was and is always present; the mind never worked apart from it. We require no separate and new psychology for manual training.

So much for the reaction upon the mind of the hand work process taken by itself alone. It is, however, generally a process that is engaged in making something which shall express some knowledge or feeling gained elsewhere. The boy does not draw lines or nail nails; he draws a canoe or nails together a house. The act of thus constructing a presentation of some idea or feeling tends to clarify the idea, make it permanent and vigorous, and to show in high lights any obvious inadequacies or errors in it. But we must not forget that children can know things without being able to draw or model them, and that they can often draw or model them excellently and know little about them. We must not forget that many a pupil can learn far more of an object in an hour spent over other people's drawings than by drawing for an hour himself. Drawing, modelling, etc., as means of expression of the ideas and feelings acquired in other courses are not panaceas, but specific drugs, to be used only under certain conditions. They are excellent servants, but very bad masters.

Let no one think that this entire analysis of ours implies anything in the least derogatory to hand work. If we find that, after all, the process is in line with all of mental life, has no mysterious private brand of excellencies, it should strengthen our confidence in its fitness as a school subject. Hand work does as much as the other school subjects for general mental development and needs no eccentric hypotheses or extravagant claims.

The Adjustment of Hand Work to the Capacities of Children

The attention of teachers of hand work has recently been called to the need of taking into account in planning courses of study the possible incapacity of young children to make fine finger movements. The question of the growth of motor ability in children is of broader reference than merely to the drawing, cutting, pasting, sewing and modelling in manual training courses. It bears equally upon early work in reading, enunciation and writing. Just as the fitness of topics and treatment in mathematics, history, geography and other sciences is conditioned by the mental capacities of children, so the fitness of all work involving movements is conditioned by their powers of motor coördination and control. The occupations of the kindergarten, the common practice of early instruction in reading from books and writing with pencil, have all been criticised as procedures that require of children precision that is beyond the proper scope of their immature nervous systems.

The problem is really a complex one, and is by no means yet settled. The first step, however, the determination of the changes in the motor abilities of young children with age, has been taken. Important passages from Bryan's "Voluntary Motor Ability"[1] and Hancock's "Motor Ability"[2] are here reprinted. Such facts as they furnish must, when properly interpreted, be taken into account in any discussion of courses or methods that involve fine movements or a high degree of bodily control on the part of young children.

We must first recall a few simple anatomical facts and

[1] *American Journal of Psychology*, Vol. V, pp. 123–204.
[2] *Pedagogical Seminary*, Vol. III, pp. 9–21.

familiarize ourselves with one or two terms. All movements are due to the contraction (that is, the shortening and thickening), or the relaxation (that is, the lengthening), of muscles. In all the performances of which we shall treat, in all those acts which we ordinarily call acts, the muscles contract because of a stimulus given them by nerve-cells in the central nervous system (motor cells). Motor ability, then, depends not only on muscles, but also on motor nerve-cells. Now the nerve-cells which conduct the stimuli to the muscles are themselves set in action by other nerve-cells, the action of which corresponds to our sensations, ideas, etc. So that our actions depend on (1) the connections of our brain cells in general with the motor cells, (2) on the proper functioning of the latter, and (3) on the proper functioning of the muscles. A person may fail to put a key in the keyhole (1) because he has never learned that it goes there, has never formed any connection between (*a*) the nerve-cells corresponding to the sight of the key and keyhole and (*b*) the motor cells leading to the muscles that move his arm and fingers. He may fail also (2) because the motor cells in question are absent, not fully developed, diseased or temporarily paralyzed. He may fail finally (3) because the muscles in question are absent or out of order.

When several muscles contract together at the same time or in series, so as to produce some definite movement, we call the fact coördinated action. When several movements together subserve some definite end, we call the fact coördinated movement. Coördination is evidently due to the connections of our brain cells in general with the motor cells. That person coördinates his movements in writing whose brain is possessed of connections between the cell processes going with hearing dog, cat, etc., and the motor cell processes leading to the muscular contractions that make one write dog, cat, etc.

Such coördinations are of the highest importance. The acts thus brought to pass keep us alive and happy. Without them we should be mere hulks of flesh. They are also means to knowledge. They put us in situations where we get new information. They also are signs of the general condition of the brain.

In the number and delicacy and complexity of the coördinated movements that he can make the infant differs from the baby, the baby from the child, the child from the adult. We have,

therefore, to ask, What movements can children at different stages of their development make? Various observers have added to and rendered more definite our common knowledge that in the early years, the first sixteen surely, perhaps more, there is a progress toward a greater number and delicacy and complexity of coördinations. The two most important of such studies we may now examine.

W. L. BRYAN: VOLUNTARY MOTOR ABILITY

American Journal of Psychology, Vol. V, No. 2 (Nov., 1892).

[Bryan tested the rapidity with which children of different ages could make the movement of tapping with a telegraph key. The movement was made in four ways: (1) by moving the upper arm up and down and hitting the key with the elbow, (2) by moving the forearm up and down and hitting the key with the under side of the forearm just back of the wrist, (3) by moving the hand up and down and hitting the key with the palm, (4) by moving the forefinger up and down and hitting the key with it. To quote the more exact account by Mr. Bryan: —]

All the joints of the upper extremities were tested. The conditions of the tests were as follows:

Shoulder.

The forearm being held at right angles to the upper arm, and the back of the elbow being held in position above the button of the Morse key, the upper arm was caused to move up and down as rapidly as possible in a plane nearly parallel with the vertical plane of the body, i.e., in about that plane in which the arm tends to swing when one walks.

Elbow.

The elbow rested upon the table. The forearm was held at right angles to the upper arm. The key was struck with the ventral side of the forearm just back of the wrist. In a few instances the arm was extended and while the elbow rested upon the table, as before, the taps were made with the little-finger side of the wrist. No difference appeared in the rate of the two motions. It is to be noted that the school experiments were made with the ordinary (spring) clothing about the arm. In my own case, the removal of my coat made no discernible difference in the rate of elbow or shoulder, owing, I think, to the great disproportion between the force of the limb in movement and the resistance which ordinary clothing presents.

Wrist.

The elbow rested upon the table. An iron clamp, whose jaws were covered with firm cushions of cloth over cotton, was placed rather loosely about the forearm just back of the wrist joint, and was held in position by an ordinary stative. The key was struck with the palm of the hand.

Metacarpo-Phalangeal Joint of Forefinger.

The palm of the hand was held with moderate firmness at an angle of about 135° with the forearm. The finger in position was then nearly or quite parallel with the forearm. In this way possible sympathetic movements of the wrist were prevented from affecting the record. If properly placed, the clamp does not interfere in the least with free movement of the finger. Other phalangeal joints were tested only in the case of adults. A narrow clamp was then used and, as in the case of the hand, interference with other joints was prevented in part by the position in which the member was held.

In all the experiments reported in this paper, the maximum number of taps in five seconds was determined, and all results are given in terms of x taps in five seconds. * * * * * * *

Seven hundred and eighty-nine school children of the city of Worcester, Mass., ranging in age from 5 to 16 years, were tested with the apparatus and by the method described. The shoulder, elbow, wrist and metacarpo-phalangeal joint of the forefinger on each side were so tested.

Classification of Results.

Forty-six individuals (twenty-six boys and twenty girls) were more or less left handed. Their records are taken account of separately (175). Twenty individuals (fourteen boys and six girls) of five years of age were tested. The boys' record is printed in Table VI. The principal calculations and results of this paper refer to the 723 right-handed individuals ranging in age from 6 to 16. The 5,784 single results obtained from these individuals were classified according to the age and sex of the individual, and according to the side and joint used.

Method of Treating Results.

The several results belonging to each class, — for example, to the right finger of the boys of six, — were tabulated so as to show the different rates found in that class (Column 1, Table V) and the number of times each of these rates occurs (Column 2). Each rate found was multiplied by the number of times it occurs, and the sum of these products (Column 3) was divided by the sum of individual cases. The differences between this result, the arithmetical mean, and each rate found were taken (Column 4), and these residuals were squared (Column 5). Each squared residual was multiplied by the number of times the corresponding rate occurs. The sum of these weighted squared residuals (Column 6) was divided by the number of individual cases. The square root of this quotient is the mean individual variation, showing the limits of distance from the mean, within which 68.3% of the individual results fall. This

individual mean variation divided by the square root of the number of cases, gives the mean variation of the mean. The probability is .683 that the true mean lies within the limits thus determined.

The tabulation and calculation for boys' right finger, 6, are given as an example [in Table V]. A designates the arithmetical mean; μ the mean individual variation, and μ_o the mean variation of the mean. The values of A, μ, and μ_o, for each class, are given in Table VI.

[The serious student should not be prevented from a thorough study of the facts of Bryan's research by the dry tabular form in which they are presented. Progress in gaining accurate information about children requires some ability to appreciate a mathematical presentation of results, and the figures in the tables to follow are infinitely more instructive than general verbal statements, once the student gains the power of reading them intelligently. Bryan's paper is one of the few which do not mix facts with inferences, or mutilate their fulness in rough statements, or fail to give exact measure of their reliability. If the reader fails to find it valuable, it testifies to his own ignorance or lack of interest in the problem.]

TABLE V

R. Rates found	T. Times each rate was found	R. × T.	V. Difference between each rate found and their average A	V^2.	$V^2 \times T$.
15	1	15	4.5	20.25	20.25
16	1	16	3.5	12.25	12.25
17	1	17	2.5	6.25	6.25
18	4	72	1.5	2.25	9.00
19	3	57	.5	.25	.75
20	10	200	.5	.25	2.50
21	3	63	1.5	2.25	6.75
22	2	44	2.5	6.25	12.50
23	1	23	3.5	12.25	12.25
	26	507			82.50

$507 \div 26 = 19.5 = A.$

$\sqrt{\frac{82.50}{26}} = 1.78 = \mu.$

$\frac{1.78}{\sqrt{26}} = .34 = \mu_o.$

[Note: — I have slightly modified the headings. — E. L. T.]

[To aid the reader in interpreting Tables V and VI, we may define A, μ, and μ_o more clearly. A (the mean) equals the average number of taps made in 5 seconds by the boys or girls of the age mentioned; μ (the mean individual variation) is a measure of the extent to which the different individuals of the sex and age under discussion varied from the average. It is clear that the same average might come from a few very quick individuals and a lot of slow ones, from a few slow ones and a lot of quick ones, from all the individuals being near the average, or from a lot of other combinations. If we took all the differences between the rates of individuals and the average rate, 68 per cent of them would be less than the amount under μ. μ_o (the mean variation or error of A, the mean) is a measure of the reliability of the A, or average. This average is gained from a few cases, generally about 30. Now, if we took 60 cases instead of 30, the average might be different. μ_o is so calculated that it tells us how different our average might be if we had an infinite number of cases. If μ_o, for instance, is .6 and our A is 15.0, we are told by it that if we took an infinite number of cases the chances are 68 in 100 that the average then found would not differ from the A we got by more than .6; that is, that the chances are 68 in 100 that the average from an infinite number of cases would be between 14.4 and 15.6.]

[The first line of Table VI, for instance, is to be interpreted thus: (A) 14 5-year-old boys in 5 seconds, tapping with the right finger, averaged 19.6 taps.

(μ) Any single right-handed 5-year-old boy that you may take will, in two cases out of three, not deviate from this rate by over 2.82 taps, will not, that is, have a rate of over 22.4 or under 16.8 taps. If we took 100 such boys at random, 68 of them would probably have rates between 22.4 and 16.8.

(μ_o) If instead of 14 boys we had tested all the right-handed five-year-olds there are, the chances are 2 to 1 that we should not get an average rate that would differ from 19.6 by more than 0.8. (The chances would be 20 to 1 against the average gained differing from 19.6 by more than 1.6, and 370 to 1 against its differing from 19.6 by more than 2.4.)

Throughout Table VI, n = the number of individuals tested, F = finger, W = wrist, E = elbow, S = shoulder, R = right and L = left.]

TABLE VI

Rate: Age 5

		Boys, n 14.			*Girls, n* 6
		A	μ	μ_o	
R	F	19.6	2.82	0.8	
	W	20.1	3.66	1.0	
	E	22.7	2.90	0.8	
	S	18.4	2.72	0.7	
L	F	17.3	3.34	0.9	Omitted, because so few.
	W	17.0	3.39	0.9	
	E	18.2	3.23	0.9	
	S	17.0	2.38	0.6	

Rate: Age 6

		Boys, n 26.			*Girls, n* 28		
		A	μ	μ_o	A	μ	μ_o
R	F	19.5	1.78	0.3	19.8	2.56	0.5
	W	23.0	2.72	0.5	21.6	2.57	0.4
	E	23.5	1.45	0.3	22.7	2.33	0.4
	S	19.8	2.81	0.6	19.9	2.71	0.5
L	F	18.0	1.56	0.3	18.0	2.76	0.5
	W	19.7	2.32	0.5	18.9	2.33	0.4
	E	20.4	2.47	0.5	19.7	2.06	0.4
	S	18.2	2.34	0.5	17.9	2.43	0.5

Rate: Age 7

		Boys, n 35.			*Girls, n* 32		
		A	μ	μ_o	A	μ	μ_o
R	F	21.0	2.64	0.4	20.7	2.46	0.4
	W	23.7	2.91	0.5	23.1	2.70	0.5
	E	24.2	3.71	0.6	23.2	1.95	0.3
	S	20.5	2.48	0.4	20.2	2.66	0.5
L	F	19.1	2.40	0.4	19.1	3.23	0.6
	W	20.2	2.60	0.4	20.0	2.46	0.4
	E	20.9	3.07	0.5	21.5	2.96	0.5
	S	18.8	2.50	0.4	18.8	2.67	0.5

RATE: AGE 8

		Boys, n 33.			*Girls, n* 32		
		A	μ	μ_o	A	μ	μ_o
R	F	23.1	2.56	0.4	22.2	2.74	0.5
	W	26.3	2.83	0.5	24.3	2.73	0.5
	E	26.1	2.57	0.4	24.4	2.68	0.5
	S	22.3	2.26	0.4	21.9	3.08	0.5
L	F	20.5	1.91	0.3	19.7	2.71	0.5
	W	22.2	2.88	0.5	21.0	2.69	0.5
	E	22.3	2.61	0.4	21.6	2.27	0.4
	S	20.2	2.69	0.5	20.2	2.64	0.5

RATE: AGE 9

		Boys, n 43.			*Girls, n* 36		
		A	μ	μ_o	A	μ	μ_o
R	F	24.4	4.15	0.6	24.0	2.69	0.4
	W	27.8	3.50	0.5	25.5	3.26	0.5
	E	28.2	3.52	0.5	25.4	3.62	0.6
	S	24.1	3.65	0.6	22.7	3.26	0.5
L	F	21.5	3.60	0.5	20.6	2.92	0.5
	W	23.6	3.84	0.6	22.4	2.99	0.5
	E	23.8	3.67	0.6	22.6	2.91	0.5
	S	20.9	3.57	0.5	20.8	3.79	0.6

RATE: AGE 10

		Boys, n 37.			*Girls, n* 35		
		A	μ	μ_o	A	μ	μ_o
R	F	25.2	2.29	0.4	24.3	2.42	0.4
	W	28.5	3.34	0.5	25.8	3.36	0.6
	E	28.1	3.60	0.6	28.5	3.66	0.6
	S	22.6	2.75	0.4	27.5	2.96	0.5
L	F	22.4	3.15	0.5	22.6	2.76	0.5
	W	24.5	3.70	0.6	22.3	2.64	0.4
	E	24.7	2.74	0.4	24.0	2.51	0.4
	S	20.5	2.85	0.5	21.6	2.62	0.4

RATE: AGE 11

		Boys, n 36.			*Girls, n* 35		
		A	μ	μ_σ	A	μ	μ_σ
R	F	27.0	3.60	0.6	27.1	3.44	0.6
	W	30.3	4.62	0.8	30.4	4.30	0.7
	E	29.3	3.41	0.6	28.6	3.44	0.6
	S	24.1	2.93	0.5	24.9	3.30	0.6
L	F	23.9	2.57	0.4	24.9	3.48	0.6
	W	25.9	3.69	0.6	26.3	4.02	0.7
	E	26.0	3.41	0.6	26.2	3.57	0.6
	S	21.5	2.57	0.4	23.6	3.44	0.6

RATE: AGE 12

		Boys, n 33.			*Girls, n* 34		
		A	μ	μ_σ	A	μ	μ_σ
R	F	29.3	5.40	0.9	28.2	3.98	0.7
	W	31.6	5.27	0.9	31.6	5.18	1.0
	E	29.9	4.12	0.7	29.4	4.90	0.8
	S	25.0	3.32	0.6	25.7	4.35	0.7
L	F	26.3	3.84	0.7	25.8	3.44	0.6
	W	26.9	3.70	0.6	27.0	4.90	0.8
	E	26.3	3.76	0.6	26.2	4.56	0.8
	S	22.4	3.59	0.6	23.6	3.64	0.6

RATE: AGE 13

		Boys, n 34.			*Girls, n* 34		
		A	μ	μ_σ	A	μ	μ_σ
R	F	28.7	3.49	0.6	30.3	4.52	0.8
	W	32.3	3.69	0.6	33.2	6.03	1.0
	E	31.0	4.44	0.8	30.5	6.20	1.1
	S	25.5	4.52	0.8	27.5	4.32	0.7
L	F	26.1	3.10	0.5	26.7	4.85	0.8
	W	27.6	3.72	0.6	28.6	4.89	0.8
	E	27.5	3.70	0.6	28.6	4.15	0.7
	S	23.7	3.81	0.7	25.2	3.83	0.7

RATE: AGE 14

		Boys, n 41.			*Girls, n* 33		
		A	μ	μ_o	A	μ	μ_o
R	F	31.5	3.69	0.6	29.5	3.02	0.5
	W	33.0	3.80	0.6	30.3	3.79	0.6
	E	32.7	4.63	0.7	28.8	2.83	0.5
	S	27.2	3.49	0.5	26.6	3.17	0.5
L	F	27.5	3.69	0.6	26.8	2.89	0.5
	W	29.0	2.61	0.4	28.0	3.70	0.6
	E	28.6	3.62	0.6	26.9	3.48	0.6
	S	24.3	3.49	0.5	23.8	3.34	0.6

RATE: AGE 15

		Boys, n 32.			*Girls, n* 31		
		A	μ	μ_o	A	μ	μ_o
R	F	31.6	4.02	0.7	29.1	3.44	0.6
	W	34.2	4.46	0.8	30.9	4.31	0.8
	E	31.5	3.72	0.7	29.3	3.84	0.7
	S	26.3	3.29	0.6	26.0	3.89	0.7
L	F	28.3	3.46	0.6	26.7	3.23	0.6
	W	29.5	3.60	0.6	28.3	3.97	0.7
	E	28.7	3.61	0.6	27.6	4.01	0.7
	S	24.7	3.58	0.6	25.4	4.14	0.7

RATE: AGE 16

		Boys, n 26.			*Girls, n* 17		
		A	μ	μ_o	A	μ	μ_o
R	F	33.9	4.92	1.0	31.3	4.66	1.1
	W	35.9	5.16	1.01	30.1	4.93	1.09
	E	32.7	3.90	0.8	33.3	4.52	1.2
	S	28.7	3.42	0.7	27.9	3.44	0.8
L	F	30.7	5.08	1.0	28.6	4.01	1.0
	W	33.1	4.70	0.9	29.5	3.87	0.9
	E	30.7	2.68	0.5	28.2	3.75	0.9
	S	26.6	3.52	0.7	26.2	3.55	0.8

The Degree of Trustworthiness of Results.

I have endeavored to state fully the conditions under which the foregoing tests were made, so that the *a priori* probability of their trustworthiness might be estimated. There are, however, two ways of determining from the results themselves their probable degree of trustworthiness. From whatever known or unknown sources of error the work may have suffered, the net errors are probably within the limits thus ascertained.

1. The mean errors of the means.

Inspection of the tables or charts shows that the limits of mean errors of the means are in all cases absolutely small, and small in comparison with the values of the corresponding means. Further examination shows:

Average of the 160 values of μ_0 for ages 6–15	.57	taps in 5 seconds
Sixty-eight per cent of these values range from 0 to	.67	" " " "
Maximum value of μ_0	1.1	" " " "

Seventy-seven per cent of the values of μ_0 are less than 2% of their corresponding means.

In sum, if an equal number of individuals, corresponding in age and sex to any class for whom means are here given, be tested under the same conditions, the probability is .683 that the resulting mean will not differ from that here given by more than .67 taps in 5 seconds, and the probability is .978 that the resulting mean will not differ from that here given by more than one tap in 5 seconds.

The relatively small number of individuals of 16 upon whom measurements could be obtained renders the means at that age somewhat less reliable:

Average value of μ_0 for age 16	.9	taps in 5 seconds
Maximum value of μ_0	1.2	" " " "
Average $\frac{\mu_0 .100}{A}$	.3%	" " " "

2. An independent means of judging the degree of trustworthiness of the means is furnished by a comparison of the results from boys with those from girls. It cannot be assumed, and is in fact later shown to be untrue, that the rates for boys and for girls of the same age are approximately equal. On the contrary, there appear clearly defined differences varying with the age examined. But if, the fact of characteristic differences between the two sexes having been established, it should appear that the two sets of wholly independent means differ from each other within very narrow limits, then it is probable that two sets of independent means obtained from individuals of the same sex would differ from each other within still narrower limits, certainly not wider ones. If the values of B—G) for the 88 possible comparisons (11 ages, 8 joints) between corresponding mean rates of boys and girls be determined, the

differences in the mean rates of boys and girls is shown to be very small. Of the 88 values of (B—G),

3	differ	by	3	taps	or	over	in	5 seconds
14	"	"	2	"	"	"	"	5 "
19	"	"	1	"	"	"	"	5 "
52	"	"	less	than	1	tap	in	5 "

In 59 of 88 cases, $(B—G) < (\mu_{\circ}B + \mu_{\circ}G)$

That is, in 67% of the cases the difference between the mean rate for boys and the corresponding rate for girls is within the limits of the mean errors of the means compared.

Mean Variation: It will be noted that the mean individual variation is subject to considerable fluctuation. Examination shows that periods of most rapid acceleration are generally periods of widening individual variation, while periods of greatest retardation or decline are periods of narrowing individual variation. The mean individual variation rarely (seven times out of 184) exceeds one tap per second.

* * * * * * * *

Variation of Rate with Age.

Inspection of the tables or charts shows for both sexes and for all joints an increase of rate with age. The total amount of increase in the rate of each joint in the ten years from 6 to 16 is shown in the following table. A change in decimal point gives the average yearly increase.

Total increase in rate between ages 6 and 16, in terms of x taps in 5 seconds:

Boys' right	F., 14.4;	W., 12.9;	E., 9.2;	S., 8.9.
Boys' left	F., 12.7;	W., 13.3;	E., 10.3;	S., 8.4.
Girls' right	F., 11.5;	W., 8.5;*	E., 7.4;*	S., 8.0.
Girls' left	F., 10.6;	W., 10.6;	E., 8.5;*	S., 8.3.

* Higher at 13 than at 16.

The amount of increase is not, however, the same each year. Table VII gives the amount of increase or decrease for each joint in each year period. Table VII*a* shows the periods of most obvious acceleration and retardation of growth.

TABLE VII

Showing amount of increase or decrease in the rate of each joint each year from 6–16 in terms of x taps in 5 seconds

AGES		6–7	7–8	8–9	9–10	10–11	11–12	12–13	13–14	14–15	15–16
Boys' Right	F	1.5	2.1	1.3	.8	1.8	2.3	—.6	2.8	.1	2.3
	W	.7	2.6	1.5	.7	1.8	1.3	.7	1.5	.4	1.7
	E	.7	1.9	2.1	—.1	1.2	.6	1.1	1.7	—1.2	1.2
	S	.7	1.8	1.8	—1.5	1.5	.9	.5	1.8	.9	2.5
Boys' Left	F	1.1	1.4	1.0	.9	1.5	2.3	—.2	1.4	.8	2.4
	W	.5	2.0	1.4	.9	1.4	1.0	.7	1.4	.5	3.6
	E	.5	1.4	1.5	.9	1.3	.3	1.2	1.1	.1	2.0
	S	.6	1.4	.7	.4	1.0	.9	1.3	.6	.4	2.1
Girls' Right	F	.9	1.5	1.8	1.8	1.3	1.1	2.1	—.8	—.4	2.1
	W	1.5	1.2	1.2	3.0	1.9	1.2	1.6	—2.9	.6	—.8
	E	.5	1.2	1.0	2.1	1.1	.8	.9	—1.7	.5	.8
	S	.3	1.7	.8	—.1	2.3	.8	1.8	—.9	—.6	1.9
Girls' Left	F	1.1	.6	.9	1.7	2.6	.9	.9	.1	—.1	1.9
	W	1.1	1.0	1.4	1.9	2.0	.7	1.6	—.6	.3	1.2
	E	1.8	.1	1.0	1.4	2.2	.0	2.4	—1.7	.7	.6
	S	.9	1.4	.6	.8	2.0	.0	1.6	—1.4	1.6	.8

TABLE VII*a*

Every joint shows an increase greater than the average yearly increase for that joint:

In boys, at ages 7-8, 10-11, 15-16. In girls, 10-11.

Seven of the eight joints show accelerated growth:

In girls, 12-13.

Six of the eight joints show accelerated growth:

In boys, 13-14. In girls, 9-10.

Five of the eight joints show accelerated growth:

In boys, 8-9, 11-12. In girls, 6-7, 7-8, 8-9, 15-16.

Five of the eight joints show an increase of rate less than the average yearly increase for that joint, or a decrease:

In boys, 12-13. In girls, 11-12.

Seven of the eight joints show retardation, or decrease:

In boys, 6-7. In girls, 14-15.

Eight joints show retardation, or decrease:

In boys, 9-10, 14-15. In girls, 13-14.

It is obvious from the tables ***** that there are certain periods when all or nearly all the joints grow at an accelerated rate, and other periods when all or nearly all grow at a retarded rate or even decline in ability; and it is clear what those periods are. Table VII*a*. The periods

of most considerable and most significant decline are for boys from 14 to 15 and for girls from 13 to 14. It will be observed that in each of these cases the period of decline is preceded by a period of acceleration and is followed by a more or less rapid recovery.

[It is of some theoretical importance to know whether the increase in rapidity is as great for the left side of the body as for the right. Between 6 and 16 years the right finger movement does improve faster than the left, so that it is, in the case of the boys, 1.7 taps farther ahead of it at 16 than at 6.

In the case of the girls it is .9 taps farther ahead. The elbow loses in both boys and girls. The wrist and shoulder vary. The figures are:

Boys	F., 1.7;	W., —.4;	E., —1.1;	S., .5
Girls	F., .9;	W., 1.1;	E., —1.1;	S., —.3

These differences are, however, very slight in comparison with the total gain.

It is also important to know whether the different movements of shoulder, elbow, wrist and finger gain equally or not. They do not. The wrist and finger movements gain in rapidity much faster than the shoulder and elbow movements. The increase in speed for boys from 6 to 16 years is, in percentages:

Finger	Right	73%	Left	77%
Wrist	"	56"	"	67"
Elbow	"	48"	"	50"
Shoulder	"	45"	"	46"

The finger thus makes about one and one-half as much improvement as the shoulder.]

[Bryan also tested the precision of movement in children of different ages in the following manner:]

School Tests on Precision

Writing Movement.

With a few exceptions, the same pupils tested in the rate experiments were tested for precision.

Apparatus: Strips of platinum foil were pasted smoothly on plate glass so as to make an angle of 2½ degrees. A small steel needle, set in a common wooden penholder, served as stylus. Three to four Le Clanche cells constituted the battery. A telegraph sounder gave the signal when the needle touched the platinum.

Course of the Experiments: The child was seated in front of the table where the glass plate lay. The latter was placed in such a position that the line along which the stylus was to be drawn should make an angle of 45°-50° with the frontal plane of the subject, when the right hand was used; and an angle of 130°-135°, when the left hand was to be used. The stylus was in each case placed between the arms of the instrument, 30 mm. from the 0 point, and drawn toward the 0 point until contact was made. Six trials were made with each hand, three movements in each case being made away from the body, and three toward the body. The point of contact was recorded. The child learned what he was expected to do as follows: (*a*) In nearly every case he looked on while one or more of his comrades went through the tests. (*b*) He received plain directions, e.g., "Take the pen; hold it so; put the point here; draw the pen so, without touching either side," etc. (*c*) He was made to try several times, until it was quite certain that he knew what he was expected to do. In some cases with very small and very stupid children, it proved impossible to make them understand what they were expected to do. Such cases, after long and patient trial, were abandoned. But records were not excluded because of being unusually inaccurate, if it could be ascertained from the child's answers and efforts that he knew what to try to do. The entire series of precision tests in the schools of Worcester was taken with scrupulous attention to every detail by my wife, Mrs. Lotta Lowe Bryan.

[Dr. Bryan's quantitative expression of the growth in precision with age is somewhat complicated. He says:]

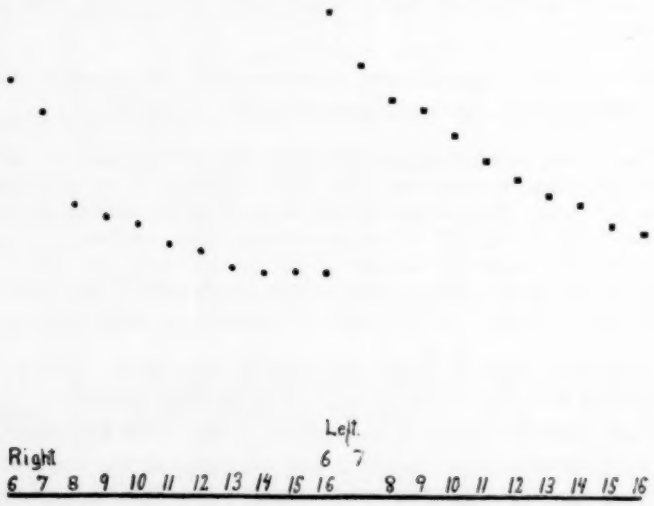
The results were classified according to the age and sex of the subjects, according to the hand used, and according to the direction of movement. Each class of results was treated by the method described, page 180. The Table XX gives the result. The numbers before the colons give the numerical weights of the results after the colons; the latter give twice the distance in mm. within which 68% of deviations fall. Results with a weight of 150 or more are printed in heavy type.

[The first line of Table XX should thus read: "About the accuracy of six-year-old boys with a downward movement of the right hand between 1 and 5 mm. on the scale of the apparatus, we have no information; between 6 and 10 mm. on the scale of the apparatus they deviate from they straight line they are trying to draw to such an extent that a band .69 of a millimetre wide would contain 68% of their lines. That is, in 68% of their trials they do not go over .345 mm. to one side or the other of the straight line. The weight of this information, its importance as a contribution to our knowledge of the precision of movement of six-year-olds, is 17. Between 11 and 15 mm. on the scale, the six-year-

olds deviate from the straight line they are trying to draw to such an extent that a band .45 mm. wide would contain 68% of their lines. That is, in about 2 cases out of every 3 they do not move the pen more than .225 mm. to one side or the other of a straight line. The weight of this information, its importance as a contribution to our knowledge, is 152. So on for the rest of the table.]

[The reader need not pay special attention to the numbers expressing the weights or importance of the different degrees of precision found in different parts of the scale. He will not be misled to any considerable extent if he uses only the figures under mm., which represent the lack of precision.]

[I have made from these data an approximate representation of the growth of precision in a diagram. The height of the points above the line represents roughly the average in accuracy of the movements tested at the different ages. For the accurate de-



Growth in precision of writing movement; right and left hands.

termination of any question, however, the tables are far better. Mr. Bryan's conclusions from them are, in part, as follows:]

Although three times as many experiments were made upon an individual in each set of precision tests as in the rate tests, and although by the method of treatment each single trial by the pupil furnished in-

TABLE XX

School Tests on Precision

Part of Scale		I 1–5	II 6–10	III 11–15	IV 16–20	V 21–25	VI 26–30
	Age	W't mm	W't mm	W't mm	W't mm	W't mm	W't mm
Boys' Right Down	6	—	17 : .69	152 : .45	304 : .44	229 : .43	—
	7	—	62 : .40	237 : .38	424 : .41	302 : .39	—
	8	15 : .23	168 : .30	399 : .30	490 : .33	—	—
	9	49 : .16	283 : .26	508 : .30	610 : .31	—	—
	10	45 : .25	251 : .26	472 : .29	214 : .35	—	—
	11	84 : .14	305 : .24	504 : .26	108 : .25	—	—
	12	61 : .17	247 : .26	423 : .28	285 : .27	—	—
	13	153 : .17	401 : .19	294 : .21	203 : .28	—	—
	14	173 : .14	433 : .20	571 : .23	238 : .27	—	—
	15	71 : .17	293 : .24	455 : .25	96 : .29	—	—
	16	48 : .27	256 : .23	366 : .25	78 : .28	—	—
Boys' Right Up	6	—	25 : .54	155 : .44	326 : .43	154 : .38	—
	7	—	72 : .45	263 : .38	448 : .40	203 : .36	—
	8	10 : .26	163 : .33	370 : .34	196 : .32	—	—
	9	39 : .16	246 : .29	524 : .31	374 : .28	—	—
	10	22 : .23	208 : .31	466 : .31	214 : .29	—	—
	11	45 : .27	288 : .27	504 : .27	108 : .30	—	—
	12	70 : .17	302 : .24	366 : .26	—	—	—
	13	80 : .16	333 : .25	392 : .24	—	—	—
	14	118 : .16	421 : .22	571 : .22	120 : .25	—	—
	15	120 : .19	398 : .20	191 : .22	—	—	—
	16	97 : .19	323 : .22	231 : .21	—	—	—
Boys' Left Down	6	—	—	62 : .59	171 : .54	305 : .54	78 : .53
	7	—	—	52 : .50	218 : .57	411 : .52	297 : .52
	8	—	31 : .52	165 : .41	358 : .48	476 : .41	99 : .42
	9	—	59 : .36	215 : .45	484 : .45	609 : .41	—
	10	—	73 : .42	248 : .38	462 : .42	320 : .38	—
	11	4 : .66	83 : .35	253 : .36	463 : .44	—	—
	12	9 : .20	114 : .33	320 : .37	462 : .34	—	—
	13	33 : .32	200 : .24	360 : .39	381 : 35	—	—
	14	13 : .20	184 : .30	418 : .33	556 : .34	239 : .34	—
	15	47 : .19	263 : .25	412 : .27	282 : .31	96 : .34	—
	16	31 : .30	194 : .24	310 : .24	228 : .33	—	—
Boys' Left Up	6	—	10 : .63	57 : .48	166 : .56	289 : .56	231 : .53
	7	—	43 : .36	128 : .40	283 : .49	427 : .48	299 : .51
	8	—	42 : .40	181 : .40	342 : .47	453 : .45	201 : .51
	9	8 : .26	104 : .32	287 : .37	498 : .45	615 : .41	129 : .44
	10	26 : .20	135 : .26	295 : .35	464 : .39	318 : .41	—
	11	11 : .20	93 : .37	298 : .34	473 : .40	214 : .36	—
	12	38 : .16	122 : .29	328 : .35	458 : .36	96 : .35	—
	13	58 : .17	223 : .22	377 : .29	471 : .34	302 : .37	—
	14	94 : .16	263 : .22	460 : .32	572 : .32	120 : .33	—
	15	56 : .17	242 : .26	406 : .27	575 : .30	—	—
	16	59 : .19	219 : .22	348 : .28	231 : .29	—	—

TABLE XX — *Continued*

School Tests on Precision

Part of Scale		I 1–5	II 6–10	III 11–15	IV 16–20	V 21–25	VI 26–30
	Age	W't mm	W't mm	W't mm	W't mm	W't mm	W't mm
	6	3 : .48	56 : .29	212 : .43	387 : .40	—	—
	7	—	41 : .53	224 : .42	399 : .40	274 : .39	—
	8	21 : .24	182 : .23	352 : .32	359 : .33	—	—
	9	24 : .21	171 : .27	394 : .32	506 : .31	—	—
Girls'	10	35 : .22	243 : .24	449 : .31	—	—	—
Right	11	89 : .18	344 : .24	487 : .27	—	—	—
Down	12	74 : .16	235 : .22	422 : .30	500 : .30	—	—
	13	53 : .21	265 : .26	463 : .26	102 : .28	—	—
	14	92 : .13	304 : .22	355 : .24	378 : .30	—	—
	15	56 : .21	294 : .22	330 : .27	366 : .30	—	—
	16	15 : .31	142 : .26	188 : .28	—	—	—
	6	—	79 : .34	218 : .43	307 : .43	83 : .41	84 : .43
	7	—	82 : .36	265 : .39	427 : .37	185 : .35	—
	8	17 : .31	169 : .29	363 : .29	361 : .32	—	—
	9	26 : .30	191 : .27	411 : .34	313 : .32	—	—
Girls'	10	38 : .27	294 : .34	476 : .25	203 : .28	—	—
Right	11	48 : .24	306 : .27	506 : .25	—	—	—
Up	12	55 : .25	283 : .25	453 : .27	303 : .27	—	—
	13	80 : .18	341 : .23	390 : .24	—	—	—
	14	86 : .20	354 : .22	460 : .22	96 : .29	—	—
	15	75 : .22	321 : .23	264 : .23	93 : .29	—	—
	16	69 : .15	213 : .22	—	—	—	—
	6	—	4 : .50	82 : .48	202 : .50	356 : .57	84 : .45
	7	—	8 : .35	122 : .45	287 : .49	434 : .48	93 : .42
	8	—	25 : .34	147 : .48	365 : .48	275 : .40	—
	9	—	33 : .43	172 : .43	383 : .51	318 : .42	—
Girls'	10	—	42 : .36	176 : .44	413 : .47	203 : .38	—
Left	11	—	79 : .31	276 : .41	465 : .38	465 : .38	105 : .40
Down	12	3 : .21	72 : .34	253 : .40	440 : .43	203 : .34	—
	13	9 : .74	146 : .30	351 : .35	482 : .34	—	—
	14	7 : .57	169 : .31	348 : .31	447 : .32	191 : .41	—
	15	28 : .22	176 : .24	323 : .32	427 : .34	184 : .39	—
	16	6 : .48	122 : .27	212 : .32	150 : .33	—	—
	6	—	23 : .40	83 : .44	202 : .54	370 : .55	84 : .48
	7	—	7 : .49	86 : .40	265 : .53	343 : .47	—
	8	9 : .34	62 : .27	208 : .42	348 : .42	447 : .44	—
	9	—	56 : .40	208 : .39	401 : .42	505 : .45	108 : .41
Girls'	10	17 : .27	102 : .28	239 : .35	421 : .42	298 : .42	—
Left	11	57 : .13	178 : .23	338 : .32	451 : .37	410 : .39	—
Up	12	34 : .22	148 : .26	347 : .32	465 : .34	303 : .39	—
	13	23 : .12	136 : .28	335 : .34	470 : .36	203 : .39	—
	14	17 : .21	146 : .32	316 : .33	342 : .35	281 : .38	—
	15	24 : .18	169 : .27	348 : .32	345 : .32	366 : .37	—
	16	21 : .27	124 : .25	222 : .27	99 : .32	31 : .33	—

formation as to the precision at many points in its course, so that the numerical weights of the precision results are many times greater than the numerical weights of the rate results, — yet the former are still insufficient to define clearly the amounts of yearly growth. This result, which evidently comes from the much greater variability in the power to make precise movements than in the power to move at a maximum rate, is itself significant; but it limits greatly the possibility of deriving trustworthy conclusions concerning the development of precision of movement. In the following, only those conclusions will be given which stand apparently clear of doubt, in connection with all information possessed by the author for determining the several degrees of probability.

Variation in the Precision at Different Parts of the Scale.

It may be observed in almost every set of results that the mean precision increases as the apex of the angle is approached. This does not, of course, mean that fewer touches per hundred trials are made, but fewer, in proportion to the space between the arms of the instrument. It seems probable that this is due to the more perfect concentration of attention as the task becomes more difficult. In all comparisons made in the following treatment, as, for example, between right and left, or as between one age and another, the results obtained within the same 5 mm. of the scale are compared.

Extreme Limit of Variation.

The total reductions in the mean deviations between ages 6 and 16 are as follows: Boys, right, down, .26 mm.; boys, right, up, .24 mm.; girls, right, down, .21 mm.; girls, right, up, .21 mm.; boys, left, down, .33 mm.; boys, left, up, .34 mm.; girls, left, down, .33 mm.; girls, left, up, .28 mm. In each case the results are given in terms of 2x, where x is the mean deviation in one direction from the straight line which bisects the angle a.

The most obvious fact which appears is the great gain made between ages 6 and 8. This can be shown by placing side by side the gain in those years and the total gain from 6 to 16.

TABLE XXII

	BOYS				GIRLS			
	R. Down	R. Up	L. Down	L. Up	R. Down	R. Up	L. Down	L. Up
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Reduction of mean deviation between 6–8	.128	.096	.098	.096	.090	.125	.095	.115
Reduction of mean deviation between 6–16	.26	.24	.33	.34	.21	.21	.33	.28

Turning to the records from 12 to 16, I am unable to draw any conclusion as to the effect of the physiological changes in that period upon the degree of precision, except that the effect is too small to appear clearly from the amount of the data possessed.

[The right hand is, on the average, superior in precision to the left at all ages (in right-handed children), but the amount of the superiority decreases markedly with age. The figures given by Bryan are as follows:]

Average superiority of R. over L. in terms of x mm.

AGE	6	7	8	9	10	11	12	13	14	15	16
Av. x,	.122	.12	.114	.101	.097	.09	.087	.06	.07	.038	.025

[Note. — The figures .122, .12, etc., represent the amount by which the inaccuracy of the left hand's movements was greater than that of the right hand's.]

[Another set of experiments on precision were made with the following apparatus:]

Paste smoothly upon a slab of plate glass a 1 sq. cm. piece of platinum foil perforated by a circular hole 1 mm. in radius and connected with one pole of a small battery. To the other pole of the battery attach by a fine flexible wire a steel needle, set in a wooden penholder. Required to hold the point of the needle at a fixed distance perpendicularly above the centre of the hole, and at command to tap the glass within the hole. A telegraph sounder gives the signal if contact is made.

* * * * * * * *

School Tests on Precision

Probing Movement.

With few exceptions the children tested by the foregoing methods were tested also for precision in the movement just described. Five trials were made with the right hand and five with the left. A board was held in position 6 mm. above the apparatus; the penholder was each time lifted until its upper end touched this board. It cannot be guaranteed that the pen will always be held in a perfect perpendicular, and accordingly the minimum distance to be moved, 6 mm., was sometimes slightly increased. If we assume what is quite certain, that in no case the pen was permitted to slant so much as thirty degrees, the maximum distance moved was always less than 8 mm.

The forearm was allowed to rest upon the table. The pen was directed mainly by the movement of the wrist, in a slight degree sometimes by movement of the elbow. Concrete directions by word and example,

as in the writing movement test, were given. No record was taken unless and until the child gave satisfactory evidence that the task required was understood. The results were classified according to the age and sex of the pupil and according to the hand used.

* * * The probability of tapping within the hole without touching the platinum was determined for each set into which the results were classified. From this probability and the known value of x, the radius of the hole, were determined the values of h in each case, and the radii of circles within which in the several cases two-thirds of the results would probably fall.

[That is, Mr. Bryan calculated from the number of times the children hit the hole, 1 mm. in radius, the exact radius that a circle would have to be in order that the children concerned would hit inside it about two out of every three times they tried, or, to be exact, 68 times out of every 100 they tried. The bigger the radius required the greater the inaccuracy.]

Table XXV gives these results and Chart V shows graphically the same facts.

[Chart V is here omitted.]

TABLE XXV

Table showing in mm. the radii of circles within which 68.3% cases would fall

AGE. YEARS	6	7	8	9	10	11	12	13	14	15	16
Boys, Right	1.10	0.97	0.87	0.80	0.67	0.65	0.53	0.58	0.60	0.42	0.44
Left	2.09	1.69	1.50	1.05	1.01	0.90	0.86	0.87	0.96	0.79	0.94
Girls, Right	0.91	1.01	0.85	0.86	0.69	0.69	0.59	0.61	0.53	0.49	0.40
Left	1.84	1.24	1.15	1.27	1.05	1.02	0.83	0.97	0.74	0.82	0.77

Resumé of Results from Precision Experiments

1. In normal individuals, the precision of voluntary movement is subject to much greater variation than is the maximum rate of movement. This test will probably distinguish pathological from normal deviations surely, only when the ataxia exists in a considerable degree, or when many tests are made.

2. The absolute size of deviations from the movement attempted decreases much more rapidly in the two or three years following the age of six than later. This is particularly true in the case of the right hand.

3. In right-handed persons, the right hand is superior to the left in precision, in about 80% of individual cases. Between ages 6 and 16, the deviations of left-hand movements decrease by a greater absolute amount than do those of right-hand movements. This is true for boys and for

girls, in both directions of the familiar writing movement, and in the unfamiliar probing movement.

4. The errors are, of course, greater with the unfamiliar probing movement under the conditions described than with the familiar writing movement. The decrease of the absolute size of the mean deviations is also greater.

5. There is little mean difference in precision between boys and girls. These results indicate a slight superiority in favor of boys.

A PRELIMINARY STUDY OF MOTOR ABILITY

By JOHN A. HANCOCK, Fellow in Pedagogy, Clark University

Pedagogical Seminary, Vol. III, pp. 9-29.

The enormous difference in ability between the child and the adult, both physically and mentally, is fully realized by few. While it is commonplace to say that there is such a difference, yet the practice of the school makes comparatively little allowance for it. Pedagogy is based on the psychology of the adult mind, and the conditions of school-room work are generally adapted to the adult. It is obvious that instruction and discipline should be adjusted to the mental and physical stages of development of children; and that we need to know just what the ability of children of each age is in order to plan a fitting course of education.

The following investigation was begun for the purpose of finding what movements children can best make; to learn something more definite of the relative ability of children and adults, and of the relation between development and decline of motor ability; and also in the hope of finding simple tests for incipient nervous diseases.

I

In directing the work of a body of teachers in the field of child study, the writer compiled the following circular. It served in his own investigations, of which this paper is a preliminary report:

THE MOTOR ABILITY OF CHILDREN

Very little study has been made of the motor ability of children. It is probable that we could teach many of the subjects of the common schools better if we knew just what movements children can make. Kindergarten training would also be placed on a more satisfactory basis.

Preyer has shown that children in learning to talk have the same difficulties as people who have diseases of speech.

Peculiar movements, such as dragging the feet, trembling of the hands or head in adults, are symptoms of certain diseases of the muscles and nerves. It will be of interest to determine whether in the normal growth of children such movements do not also appear.

It has been suggested that certain nervous diseases of children begin while they are yet able to attend school, and that by simple tests, cases of such diseases may be determined during their school stage.

To aid in solving these problems the following tests have been gathered from various sources, and are now offered for trial and criticism.

In testing pupils take two or three of them at a time, before or after school, noting which time. Record age, sex and nationality. Use but one syllabus at a time — the other some days later. If it should seem best to you, omit any one of the tests. If the pupil shows signs of fatigue, do not continue testing him. Give absolutely no help other than indicated in the directions, for results obtained can not show in any way the value of your teaching. The most insignificant looking paper is often, to the expert, the most valuable; so make no effort to make your returns "show up well." Number your results to correspond with the tests.

First Series

1. [1]Ask the child to stand with feet close together and hands at sides. Is there any swaying of the body? Try same with eyes closed. What difference?

2. Have him walk across the room backwards with eyes closed. (Keep near him to prevent falling.) Is there any dragging of either foot, walking with feet wide apart, or turning to right or left?

3. Have him try to sit still a half minute exactly. Note all the movements he makes in the effort. Does he hold his breath?

4. Ask him to close his eyes and hold his hands out horizontally with the fingers spread. Is there tremor or twitching of the fingers? Which ones and in what directions? Is it slight or distinct?

5. Hold your hands above your head out of sight and with palms front. Ask him to do the same. Does he raise them to the same height? Hold them symmetrically? Are the fingers or thumbs spread apart on either hand? Which? Which hand sinks first on a half-minute's trial? Hold up your own hands but a moment.

6. Place him ten feet away. Toss back and forth ten times a ball as large as a tennis ball. How and where does he throw it? How many times does he catch it?

7. Ask the boys to lie down on their backs, if they are willing. How do they get up? Have they difficulty?

8. Ask for the pronunciation of these letters and words and note errors: r, l, s, t, k, d, f, n, v, y, go, which, thin, the, long, show.

9. What signs of mental fatigue have you noticed in him in school work? Has he made any involuntary movements during these tests?

10. Please add any comments or suggestions that may occur to you.

[1] The swaying may be charted exactly and easily; if desired, directions will be given.

Second Series

1. Does the child dress himself? Button his clothing, and fasten hooks and eyes?

2. Can he tie the ends of a string together? In what kind of a knot?

3. Can he thread a needle? How small a one? In which hand does he hold it?

4. Can he interlace slats? Interlace four and six before him? See patterns one and two. Does he even copy the pattern?

1

2

3

4

5. Can he wind thread on a spool? How does he do it?

6. Can he spin a top made of half a spool or button mold? Can he snap a marble?

7. Can he hop on each foot? Stand on tip-toes or heels? Touch his knees or shoes while standing?

8. Place before him pattern number three; give him squares of paper or square blocks; ask him to imitate it. Then show him number four. Does he shift the outer blocks of number three to make the other figure, or does he build anew from the beginning? The patterns may be shown him drawn full size on paper, or made of the blocks. If he fails, divide each pattern vertically in the middle; try him and note results.

9. Count and beat time, double, treble and quadruple. Can he do it? Rapidly?

10. Does he swing his arms or sway his body when walking? Can he march, keeping step as you count time or play for him? Can he run and keep time? Does he, when marching, move the head, eyes, mouth or tongue?

11. Pat the top of your head and at the same time move the other hand in a circle on the breast. Can he imitate you?

12. Rest your forearms on the table, the hands in an easy position with the fingers curved, and the lower parts of the palms and the tips of the fingers touching the surface of the table. Begin tapping, letting the movements proceed rapidly from the little fingers to the thumbs. Ask him to imitate you. Notice the movements he actually makes. Are they with the hand and arm moving together from the elbow; the whole hand moving from the wrist; all of the fingers moving in unison from the knuckles; or with index finger alternating with the other three? Reverse the tapping, beginning with the thumbs. Can he imitate you any better? Just what does he do?

13. Can he drive a nail, or hit it squarely after several trials when started for him?

14. Can he roll a hoop? Skate? Turn a somersault or walk on his hands? (The boy, of course.)

15. What movements seem to you to be most difficult for children to learn?

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Belfield, *Manual Training and Public Schools.* Industrial Educational Association, New York.

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The small numbers in the text refer to the following:

1. Dana, *Text-book of Nervous Diseases,* p. 38.

2. Bullard and Brackett, *Boston Medical and Surgical Journal,* Vol. II of 1888, pp. 600–603. Also Vol. I, p. 136.

3. Hinsdale, "The Station of Man." *American Medical Journal,* Vol. XCIII, pp. 478–485.

4. Jastrow, *American Journal of Psychology,* Vol. IV.

5. Bullard and Brackett, *Boston Medical and Surgical Journal,* Vol. II of 1888, p. 598.

6. Bryan, "On the Development of Voluntary Motor Ability." *American Journal of Psychology*, Vol. V, No. 2.

7. Sturgis, *Report of Congress of Hygiene and Demography*. London. Part IV, pp. 20–27.

One hundred and ten of the children tested are in the public schools of Worcester, fifteen are in a Catholic orphanage, and the remainder in a parochial school. The ages of the children are five, six, and seven. All were in the first year of school work. The children in the orphanage, though mainly from the homes of the very poor, were well cared for. One of the public schools uses a modification of the kindergarten work in connection with the usual primary work. No rejection of any child was made except when over seven years of age.

Previous to beginning work, the school was visited and an effort was made to become acquainted with the children. The children were told that no one need be tested unless willing. In three cases children refused, but later came voluntarily and asked to be tested.

At the outset the work was found to be fatiguing to the children. It was accordingly divided into three parts and the round of the school taken with each.

The experiments had in large part to be made in hallways, but this did not seem to make any difference. City children, like their elders, pass and repass people many times each day and pay no attention to them. Rarely was head or eye turned to chance passers.

Two children were sent out at a time. Generally one or more teachers were present as well. At one school also, a boy was present "who, for being good and working hard," was permitted to come out and see the "machine"; and twice a girl from a higher grade, who came down stairs "with the nose-bleed," spent two hours in "helping."

In the effort to train the intellect of the child, considerable quiet is demanded of him. It is one of the "faults" of children, in the minds of many teachers and parents, that they do not keep as quiet as the adult. The quiet child who sits through the sermon, or who sits still when callers are present, and who does not tear or soil its clothing, is liked and given the reputation of being good.

With the purpose of studying the ability of children to keep quiet, the first test was devised. The apparatus used is known as the ataxiagraph. (1) It consists of an upright support, to which is attached an adjustable arm about two feet long. At its extremity is attached a large cork. A small glass tube passes through it. Within the tube, working up and down, is a glass rod about six inches long, and drawn to a point at its lower end. On the upper end is attached [a] small cork to keep the rod from falling through. A piece of smoked paper is pasted to a glass plate, four by five inches, at the edges. The plate is then ready to attach to a cap. This should be a flat-topped one with a rubber band, under which the plate can be secured at one edge. After the tracing is taken, the plate is removed, the paper cut off, and given a bath in shellac and dried.

Since it appeared that the position taken by the subject required a coördination of a large number of the largest muscles of the body, this test would show something of the control of them. The child was asked to stand with feet close together and hands at sides, to keep his attention on a distant object, and to try to stand still for a minute. After this was done he had half a minute or more of rest, when the test was repeated with eyes closed. Specimen tracings for men and children under similar conditions are given.

No device was available for measuring the amount of movement exactly. It is in almost every case very much greater for children than for men. The rectangles which would just contain these tracings in the anterio-posterior and lateral directions were measured. In thirty cases the tracings were repeated at a later date without material difference in the rectangles, and with fully as miscellaneous movement.

Bullard and Brackett (2) studied the swayings of 150 men who were between the ages of twenty and thirty. They were competing in a physical examination and were all in good health. They were tested for a half minute only. As this fact was not learned till the tests on the children were well under way, a number of tests were made on men for a whole minute, but without material variation from the averages of the 150. These averages found by Bullard and Brackett were, with eyes closed, 3.764 cm. in the anterio-posterior direction by 1.951 cm. laterally; with eyes open, 3.475 cm. by 1.963 cm. Hinsdale found (3) that normally the anterio-posterior measurement was one-third to one and one-half inches, and that swaying generally increased when eyes were closed. His tests were for a minute. He had but twelve subjects — young men in good health. The average measurement of these men was 2.55 cm. by 2.1 cm.

He found ataxic cases to sway from 5.7 cm. to 7.0 cm. in anterio-posterior direction by 6.35 cm. to 8.2 cm. laterally.

He measured, also, ten cases of chorea. The anterio-posterior average was 1.35 in. (5.5 cm.); the lateral average, 1.45 in. (3.7 cm.).

The averages in my own tests are as follows:

	EYES OPEN	EYES CLOSED
35 boys, 5 years old,	5.8000 cm. by 5.2228 cm.;	6.6810 cm. by 5.7675 cm.
22 girls, 5 " "	5.7773 " " 4.9500 "	5.5400 " " 5.0954 "
47 boys, 6 " "	5.1148 " " 4.2660 "	5.6957 " " 5.1637 "
18 girls, 6 " "	5.0611 " " 3.7277 "	5.6000 " " 4.3333 "
23 boys, 7 " "	4.9608 " " 4.2434 "	6.0086 " " 5.4521 "
13 girls, 7 " "	3.9538 " " 3.2769 "	4.8230 " " 3.7615 "

One hundred and ten were steadier with the eyes open than with them shut; forty-eight, with eyes closed; in two cases there was no difference. The child being shorter, would sway less than a man, were other conditions the same. In point of fact there is a significant difference in the other direction.

With eyes open there is an increase of control in each year. The girls are steadier than the boys. Both of these facts were to be expected,

since girls mature earlier than boys, yet if the number of subjects was larger, and equal for each sex, a different result might be found.

During these tests frequent twitchings of the fingers were observed in a large majority. Out of this and the many other involuntary movements came the suggestion to try the steadiness of shoulder and finger, and so to get some comparative results for control of large and small muscles.

The instrument named by Jastrow the automatograph was used. It is described by him as follows: (*) "There is first a piece of plate glass, fifteen inches square, resting on a stout wooden frame; this frame is mounted on three adjustable brass legs, raising it an inch or so from the table. By means of the screw adjustment of the legs, the plate glass is brought into exact level. Three brass balls, which must be very perfectly turned and polished spheres, about three-fourths of an inch in diameter, are placed in the form of a triangle upon the plate; upon these balls rests a very light wooden frame. The recording of the movement is equally simple." To the light frame is attached a slender rod about six inches long, bearing at its end a device the same as used to mark the movement in the ataxiagraph. A screen is used to prevent the subject from seeing the record.

No tests so far as known having been made for this particular purpose, trials were first made on twenty-five of the Clark University men. The subject was seated with back supported, the hand and forearm resting with palms downward on the instrument, the elbow slightly flexed, in order that no strain might be brought on the muscles controlling it. The position admits of free lateral movement of the shoulder and of very little in a direction perpendicular to the body. The subject was asked to hold his arm still for a minute. He was told to do this as he looked at his hand. After an interval of a half-minute or more for rest, the test was repeated with the eyes closed. The averages for both men and children are as follows:

	EYES OPEN		EYES CLOSED	
	Perpendicular Movement	Lateral Movement	Perpendicular Movement	Lateral Movement
25 men,	.242 cm.	by .752 cm.;	.156 cm.	by 1.460 cm.
18 boys, 5 years old,	.816 "	" 3.400 "	1.027 "	" 4.916 "
15 girls, 5 " "	.833 "	" 3.940 "	.780 "	" 4.706 "
34 boys, 6 " "	1.191 "	" 4.258 "	.805 "	" 5.058 "
12 girls, 6 " "	.433 "	" 3.883 "	1.825 "	" 4.166 "
14 boys, 7 " "	.500 "	" 3.750 "	.428 "	" 5.207 "
10 girls, 7 " "	.410 "	" 3.580 "	.480 "	" 3.550 "

The relative difference in the control of child and man here is greater. The rectangles are smaller because the levers are shorter, for one thing. The measurements in the case of the children are unsatisfactory so far as the perpendicular movement is concerned. The difficulty of keeping the children from moving the body, although it was well supported, was so great that this measurement is of little value as a test of control of shoulder movement. The breathing, also, influenced it more

than it did the lateral movement. Recesses in all the schools were so short that the chances for active play unsettling the steadiness of the muscles were very slight.

Bullard and Brackett (⁸) used in testing the control of the entire arm an instrument known as the tremograph. It is described by them as follows: "It consists essentially of a long, light wooden rod, which runs through a closely fitting brass cylinder so hung in a vertical compass joint on the top of a firm upright as to permit of movement both vertically and horizontally in all directions. One end of the rod is furnished with a thimble, or some other contrivance, for holding the finger, while to the other is attached a Pfluger's pen. Various weights are attached to the rod in order perfectly to balance it. The upright, made of brass, is placed in the centre of a rectangular wooden platform with low grooved sides, into which it fits closely. At one end of this platform is a transverse groove. This groove serves to hold the glass plate, over which the paper for the tracings is stretched, while the board supports it behind."

The subjects sat with back supported, the forearm and hand resting on the table, palm of hand downward with tip of finger resting in the thimble, the thumb and other fingers so placed that no strain or effort should be felt in them. Early in the work, the fact developed that children could not hold their attention for a whole minute on the index finger as requested. No amount of persuasion availed. After a half-minute, and sometimes before, all control of the finger seemed lost, hence the finger tests were all made for a half-minute on both men and children. Control of the muscles and attention seem to me to be too closely associated in young children to permit study of either separately.

The instrument multiplies the movement four times; the results are reduced accordingly. The same university men gave tracings for this test. The following are the results:

	EYES OPEN		EYES CLOSED	
	Vertical Movement	Lateral Movement	Vertical Movement	Lateral Movement
The men,	.0975 cm.	by .0911 cm.;	.085 cm.	by .110 cm.
17 boys of 5,	.985 "	" .532 "	.794 "	" .680 "
14 girls of 5,	.580 "	" .337 "	.714 "	" .453 "
32 boys of 6,	.396 "	" .378 "	.689 "	" .543 "
12 girls of 6,	.394 "	" .319 "	.535 "	" .395 "
13 boys of 7,	.419 "	" .282 "	.693 "	" .442 "
8 girls of 7,	.300 "	" .356 "	.312 "	" .365 "

The same general relations hold in this table as in the others.

Reckoned in terms of the nearest centimeter, the anterio-posterior swaying of men and children are as follows:

CM.	0	1	2	3	4	5	6	7	8	9	10
150 men	1	20	37	48	24	11	9	6	2	1	0
Children	0	16	1	11	31	45	35	13	13	7	2

The following will show the ranges in lateral control for the shoulder:

CM.	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	5.5	7.0	7.5	8.0	8.5	9.0
25 men	0	2	3	2	3	2	2	2	2	3	4	0	0	0	0	0	0	0	0	0	0	0	0
35 5-yr.-old boys	1	0	0	1	0	0	0	0	0	0	3	3	7	4	1	6	1	1	2	1	1	1	1

The chart shows the ranges for the finger.

[This chart is here omitted. — E. L. T.]

Bryan (*) has shown that the rate of tapping for the child of sixteen is about five times (note) as great as for one of six, and that hand power is later than arm power in developing, but gains and eventually surpasses the arm power. Taking the rectangles of the standing and finger tests, and the lateral measurements of the shoulder test, the ratio of control between a man and a five-year-old child in the swaying test is as 1 to 4.1; for the shoulder, 1 to 4.5; for the finger, 1 to 5.8. While these results may not stand with more extended research, the truth evidently lies in the direction they indicate; and, in my opinion, the motor control in man is from three to six times greater than that of children in the first year of school life.

The order of control is from fundamental to accessory, and is evidently in harmony with the theory of physiological development.

[Note. — This is presumably a typographical error. The rate in question is about *twice* as great. — E. L. T.]

II

The following results are from simple and general tests, and throw some light on the motor ability of children to make complex coördinations, both of larger muscles and of smaller ones.

A pattern found in most of the kindergarten guides consists of four slats interlaced. This was taken for a test, using slats eight inches long and one-half an inch wide. Four were taken and interlaced before the children, and left so for them to see; four others were then given to each child, and the children were asked to interlace them. The slats were interlaced a second or even a third time before the children, yet but one child — a girl of six — succeeded; nine copied the figure, the remaining fifty failed wholly. There was not opportunity to test more.

Test number twelve of the second series gave significant results; 162 children were tested with this, none of whom succeeded in reversing the movement; five succeeded somewhat slowly in tapping correctly with both hands; four were successful with the right hand only, and three with the left; fifty tapped with the whole hand, using a wrist motion;

nine with the whole hand, using an elbow motion; five with the whole hand, with both an elbow and a wrist motion; forty-nine alternated the index finger with the other three; seven of these, however, did this with one hand only, the movement of the other being with all the fingers moving together from the knuckles; twenty-five gave irregular movements indefinite and uncertain, but in many instances approaching success; in twelve cases the movement was from the knuckles, all of the fingers moving together.

I am not concerned at present with the effect of training on the ability of children to make these movements, but rather with the problem, What is the period of the development of function in the nerve centres controlling the finer muscles concerned in delicate coördinations? Evidently for these children it is only beginning.

Fifty-six boys were asked to thread a large needle; fifty succeeded, but often only after two or three efforts; six failed, though given extra large needles and more time. It was evidently new to most of them. After the first trial there was in many cases apparent a feeling of nervousness.

Twenty-two out of sixty-three children failed in the effort to tie the ends of a two-foot string together. Those who succeeded tied, in every instance except four, the ends by placing them side by side. This is the simplest form in which it could be done.

In the tests for the coördination of the larger muscles, far less difficulty was experienced. The eleventh test of the second series has often been tried by older people, and in some places by children. It was new to the children reported on here. The novelty first amused them, yet all but three asked made an effort to get the movement. They were first asked to make one hand move in a circle on the breast; after this was started, they were asked to place the other hand on top of the head and pat with it. In forty-five cases the result was either patting with both hands or moving them both in a circle. In the other ninety-seven cases there were first unsuccessful movements, often patting with both hands, or moving both in a circle, or an alternating of these, but a considerable degree of success followed in each case.

One hundred and sixty were shown how to beat time. Arm movements were used. Practically all could beat double time freely. Treble and quadruple were more difficult, but by going slowly it was done by all but fifteen. Not more than two minutes' time was taken with each test; and it seems reasonable to suppose that, with ten or fifteen minutes' careful training, all could succeed.

Details of individual cases are of interest. As showing something of the range, these three are given:

M. is a girl of six years. She has now had about eight months' schooling, all told. Her teacher speaks of her as one of the brightest pupils. The rectangles for the swaying test were 3 cm. by 4.1 cm. and 4.4 cm. by 2.9 cm. These are among the smallest. The lateral movements for the shoulder were 3.8 cm. and 3.1 cm. These were not so small as many others. For the finger the rectangles reduced were .075 cm. by

.05 cm. and .15 cm. by .05 cm. Here, again, she is among the best. She could walk normally with the eyes closed. One finger trembled when she was tested for tremor, but she was quite free from all trace of tendency to chorea. In the tapping test she used a wrist movement for the whole hand, yet she was the only child who succeeded in interlacing four slats. She had no difficulty with any of the tests for the use or coördination of the larger muscles. Her general appearance is that of a healthy, intelligent child. B., a boy of five years, is one of the interesting cases at the other extreme from M. He is one of his teacher's "third best; bright as could be expected from *him;* not very good in his lessons, but *not* a bad boy." His results in the first test were 5 cm. by 2.4 cm. and 8.5 cm. by 4 cm. He so thoroughly lost his balance with eyes closed that he was caught to save a fall. The lateral measurements for the shoulder were 3.3 cm. and 2.2 cm. Here he did his best. The rectangles for the finger were, reduced, .35 cm. by .075 cm. and 1.2 cm. by 1.4 cm. He seems some stronger and brighter than his twin brother, yet the brother's measurements were some better. He shows decided tendencies to chorea, and is generally somewhat nervous. He cannot speak distinctly, failing on r, l, f, th, and ng. He failed wholly on the tests for finer movements, while in those for the larger movements he succeeded only in beating time. A., B.'s sister, is six years old, and is one of her teacher's "second best; she tries hard, but does not succeed so well as some." In the first test her measurements were 4 cm. by 1.8 cm. and 8.5 cm. by 3.5 cm. The lateral movements for the shoulder were 1.2 cm. and 5.2 cm. For the finger they were, reduced, .35 cm. by .5 cm. and .525 cm. by .25 cm. She also has strong tendencies to chorea. In the tests for the control of the finer movements, she was able to differentiate the control of the index finger; she could beat double time only, and failed wholly on test number eleven of the second series. She and her brother are Irish, plain looking, though not stupid, yet evidently not amongst the teacher's best.

The results thus far seem to justify the following inferences, though more extended research may change or modify them.

Children early learn to make movements involving large muscles. They succeed easily in large movements of some degree of complexity. The order of development of control is evidently: body, shoulder, arm, forearm and hand. In the hand control the index finger differentiates before that of the others.

Fine and complicated movements are made with difficulty.

Efforts to keep quiet produce strong symptoms of nervous irritation. Movement is inhibited only in part, and awkward swayings and twitchings result.

Children have far less control of their muscles than adults, as is shown in each of the tables.

Generally, the girl at the same age is steadier than the boy.

Children in normal, healthy growth show a lack of coördination and control paralleled only by ataxic, choreic and paralytic patients.

In support of this, there were found thirty-eight, out of one hundred and fifty, dragging the feet or walking with them wide apart when eyes

were closed. The swayings of a very large number equal or exceed that of the ataxic patient. With test number four of the first series, in fifty cases there were twitchings and tremor in both directions. In twenty-six cases there were twitchings forward and backward only, and in twenty-seven there were twitchings sideways only. Perhaps the twitchings were noticed more in the left hand, and there in the ring finger. Considerable care and practice are necessary to see and determine these. If this test is of value, apparatus for measuring and recording should be devised and used.

Sturgis's test for choreic tendencies showed that but half of one hundred and fifty children tested were free from them. To show the importance of a knowledge of chorea and the value which Sturgis places on this test, I give here his own statement: (1)

"1. Movement disorder is the product and the index of mental disturbances, and may be known by nice observations of the higher muscles (the face and hands) before it has reached the stage to which the term St. Vitus' dance (or chorea) properly applies.

"2. When the school child (and especially girls between seven and twelve or thereabouts) alters in temper, works less well, less willingly than usual, gets untidy or slovenly — in a word, degenerates mentally and bodily, inquire of the mother as to home conduct and temper. Ask particularly how the child sleeps, and whether she complains of headache or limbache, and whether her food is sufficient.

"3. Amongst the incidents of school life apt to be injurious, in the way we are considering, there stand out prominently examinations, moving into a higher class, sums (too difficult or ill explained), and punishment or admonition before fellows.

"4. The best index of muscular infirmity tending to St. Vitus' dance is the hand. Face mobility may be mere nervousness, the tongue may be tremulous by nature. The hand test is infallible, and may be thus applied:

"Bid the child hold up both hands open, with extended arms, the palms towards you. If that is done steadily, both hands upright, and both alike, no finger or hand quivering, no falling back of either hand, nothing to choose between the positions of the two, then the child has not nor is it near (either before or after) St. Vitus' dance. You may confirm this test by another. Let the child place the open hands upon yours, palm to palm. Look then at the backs of the child's hands, observe whether fingers or thumbs (especially the latter) repose without tremor and without restraint."

In the gradual acquisition of control of its muscles the child needs to be carefully guarded from inconsiderate treatment. He should, if chorea seems at all imminent, be taken out of school, freed from responsibility, and given for some weeks a quiet out-of-door life, with plenty of nourishing food and as much sleep as possible.

From these studies one gets a fairly accurate though complex and incomplete account of the changes in the motor ability of children, changes which progress with age toward greater precision and more perfect control.

What, now, are the general causes at work in producing those changes? As usual, we have to choose among (1) inner development that comes as a consequence of growth, as a gift of nature, (2) learning or experience in making coördinations, and (3) general changes in intelligence that make pupils understand better what they are asked to do and try harder to do it. As elsewhere, the practical consequences of the acceptance of any one of these theories about the development of motor ability are tremendous.

It may be said at the start that all three factors are at work, and that the question is to assign the proper share to each.

We shall get along better if we restate the question by dividing the fact of coördination into two facts. Let us speak of the anatomical concord of movements and the psychological association of movements. By the anatomical concord of movements let us mean the contemporaneities and sequences of movements so far as determined by the structure of the nervous system due to its inner growth, and by the psychological association of movements let us mean those contemporaneities and sequences which are due to learning, practice. Instances of the former would be the simultaneous contractions and relaxations of the sets of muscles moving the two eyes by which infants at an early age move both eyes together in following an object, the simultaneous contractions of the muscles which hold the forefinger straight and extend the arm, the successive contractions by which the legs are moved in walking or the vocal cords, mouth, etc., moved in crying or babbling "ma." Instances of the latter would be the contractions causing us to hold the pen and also move it in writing, to say, "Ma — ma — please — give," in order. The second sort evidently develops out of the first sort. Unless there were given structures in the nervous system causing such movements as produced the babble of infants, we could not, by learning to put different modifications of these movements together, have the psychological associations causing articulate speech. And until these concords are given the associations must wait.

If the concords for grasping appeared first in the tenth year,

instead of the first month, children could not form the psychological associations of using knife, fork and spoon until then. But once given certain elementary combinations of coördinations, and we go on smoothly to recombine them, to add to and subtract from them, and to connect them with others.

There is one further matter to make clear, if possible, though it does not admit of full comprehension by those unacquainted with the finer anatomy of the brain. Just as cell structures grow and develop connections which are manifested in the anatomical concords we have mentioned, so cell structures and connections may develop which are not openly manifested in any coördinated movements, but *which permit such movements in case circumstances coöperate.* For example, it would seem as if the movements of the vocal chords, etc., involved in the imitation by hunters of the calls of wild animals were not necessarily openly manifested. Many people who could make them never do. Those who do make them make them years perhaps after the possibility of making them was first present. We cannot be quite sure of this, but it seems likely that the inner growth of the nervous system brings about not only actual movements which we modify by learning, but also possibilities of movements which we may or may not realize. In the case of these as well, provided they exist, we should have to wait until inner growth gave the possibility before we could have the actual performance.

The practical import is simple enough. (1) It is folly to try to teach children to make any coördinated movements for which the necessary anatomical concords, either openly manifest or not, are not yet developed. It is as foolish as to try to teach the six-year-old to look over a fence six feet high. (2) It is conceivable that there is an optimum time to teach different classes of movements, a time when the anatomical concords on which they are based are readiest to be modified with least likelihood of injury to nervous health.

If we knew just the times when the different anatomical concords were developed, and on just which of them the different movements used in reading, writing, drawing, manual training, sewing, etc., depended, we could so plan our courses of study as to take the tide of nervous growth at its full. We could avoid premature efforts that would be bound to end in failure. We would save children from learning with difficulty and danger

things they might, earlier or later, learn with ease and profit. We do not know the times when the different concords are developed, nor even their order.

This ignorance results in all sorts of opinions and hypotheses. The immaturity of the nervous system is used by some as an argument against the introduction of reading or writing before the age of ten, against many of the kindergarten occupations, against all fine manual work in the three or four lowest grades. We find physicians protesting that the schools everywhere demand of the nervous mechanisms of children fine movements, which they either cannot do at all or can do only at the expense of health. We find in some cases these same physicians advocating fine finger movements as remedial treatment for children whose nervous mechanisms don't work well. We find intelligent teachers who have watched the results of fine movements on the children who were forced to make them, unaware of any signs of evil results.

One notable theory of the order of the development of these anatomical concords is that those concerned with the fundamental or trunk muscles come first, and those concerned with the muscles of the extremities later. Of these latter those concerned with the muscles nearest the trunk precede.

Most of the writers about coördinated action as a result of inner growth are very free with general statements and very chary of any definite dates and still more so of any proof that their dates are correct. For instance, no one has proved that any of the nervous basis necessary for the associations involved in the reading, writing, drawing, cutting, pasting, measuring, modelling, sewing, etc., commonly taught in schools is delayed in appearance till after the fifth birthday. And it is hard to explain the infant prodigies who play the piano or violin at four or five, who learn to read Latin before they are seven, who do gymnastic and juggling feats, etc., if we agree that fine movements of the hands, eyes, etc., develop late. As to the general law that movements develop in the order of their grossness, the coarser ones first, it is completely false as a complete account. Darwin pointed out that one of the first coördinated movements to develop was one of the finest, namely, the curling of the toes and grasping by the fingers. These movements of the extremities come long before many movements of the trunk, shoulder and thighs.

There are certain lines of evidence in the articles quoted which emphasize the importance of inner growth as a cause of the improvement with age. Bryan, it will be remembered, found that in both rapidity and precision of movement the left side of the body improved as much as the right. Now this would seem to show that training could have little to do with the improvement, since the right side would be trained in the movements tested much more than the left. Oddly enough, in the experiment on the ability to draw a straight line, the case where practice would seem to be of the most importance, the left hand improves more with age than the right. This equal progress of both sides is perhaps the strongest argument for belief in the growth of motor control as the result of general physical growth, and it should have much force. At the same time we must remember that any increase in general intelligence due to training would improve the records of left as well as right. Moreover, there is a tendency for any one making a simple movement with his right arm to contract the corresponding muscles in the left arm. We may thus get unconscious practice of the left arm.

There is also a set of facts among Bryan's results which, if we regard the progress of the left side of the body as evidence that training is an unimportant factor, supports the theory that the order of development of motor coördinations is from the trunk muscles toward those of the extremities. Bryan found that from 6 to 16 the finger improved most, the wrist next, the elbow next, and the shoulder least. The percentages of gain in rapidity for boys I calculate as:

Right	F	73	per	cent
	W	56	"	"
	E	48	"	"
	S	45	"	"
Left	F	77	"	"
	W	67	"	"
	E	50	"	"
	S	46	"	"

Excluding training as a factor, it would seem that the finer movements reached the same relative level of control later as the large movements. However, we should note that there was no very obvious early " ripening " of the shoulder and elbow movements. They keep improving right up to 16 years, just as do the finger movements, though not so fast.

There are, finally, some facts in Bryan's study which may be taken as witnesses against the importance of inner growth as a factor. If the control of, say finger movements, comes with mere maturity, we should expect the increases in rapidity of tapping, accuracy of drawing a line and accuracy in the probing movement to follow the same general progress. They should have the same accelerations or retardations in rate, the same general character in all respects, for they would, by hypothesis, be due to the same causes. They do not. The peculiar pre-pubertal phenomena in the case of the rapidity of movement do not appear elsewhere. The extremely rapid rate of improvement from 6 to 8 years in the case of the straight-line movement does not appear elsewhere.

If we know little about the dates of appearance of the different nervous structures which make the psychological associations possible, we know still less about the degree to which they are perfect at the start or the extent to which mere growth perfects them or the way in which it does it.

The best practical attitude for the teacher of children 6 to 12 to take would seem to be to find out, by trying, the most economical time to teach the movements he wished the children to know and to make sure, again by trying, that they do not hurt the children's health. Whether they will or not cannot be told beforehand by any theory about the development of the brain by virtue of its inner growth, but only by observing directly the signs of brain-exhaustion.

What movements a child can profitably learn depends not only on what anatomical concords are present, but also on what psychological associations have been built up. If we wish to teach a child to carve an Indian out of wood, we require not only that he shall have a nervous mechanism allowing him to grasp, hold, move his hands and fingers freely, but also that he shall have learned how to hold the knife, how to cut so as to take off a small or large piece at will, how to cut in an eighth or a quarter of an inch at will, etc. The influence of previous experience is as potent in the case of making movements as it is in the case of thinking thoughts. If the child of eight can learn to write more quickly than the child of five, it is in great part due to the fact that in the three years he has had experience of the finger and wrist movements involved, in his use of knife and fork and spoon and

pencil and toys, and so on. We can never estimate how much inner growth does for him until we learn how much experience does for him and deduct that much from his total advance.

Increase in motor ability, we said, was also dependent on general changes in intelligence, that make pupils understand better what they are asked to do, try harder to do it and, we may add, know how to go about it. Just as an intelligent man will, other things being equal, make a more accurate drawing, a better dissection, a neater machine than a stupid man, so, even if inner growth and practice had no efficacy, the ten-year-old would do better than a five-year-old because he had gained a general fund of knowledge and sense.

SPELLING

How children learn to spell English words would seem to be a fairly easy thing to find out. There is such an abundance of data and the process involves so few factors that the causes of good and bad spelling would seem to be among the first facts for students of children to find out. The practical importance of the discovery should, one would suppose, have made it one of the early triumphs of child study; for all sorts of remedies had been proposed and all sorts of methods of teaching had been in vogue.

Oral spelling, written spelling, sentence writing, spelling books, no spelling books, extensive reading, etc., — all had been indorsed each as the way to make good spellers. Individual experience and expert opinion were evidently incapable of settling this simple question of a method to get children to remember the letters corresponding to words. In fact, the pessimists have claimed that, the more expert opinion deemed itself, the worse the spelling grew. If any one method was the right one, there was a tremendous waste of time in the use of the others.

To Dr. J. M. Rice belongs the credit of having seen the necessity of an investigation of the actual facts. Dr. Rice tested the abilities of children taught by all the different methods, of children who had, some 15, some 30, some 40 minutes of spelling work daily, of children who read largely, and who read but little. He made the brilliant, if exasperating, discovery that it made no difference. Fifteen or forty-five minutes' drill, reading habits or no reading habit, oral or written — all were alike in the spelling produced. I have not permission to quote his report in full, but the following abstracts and quotations present the essentials of his method and results. A full account may be found in the April and June numbers of the *Forum* for 1897.

Dr. Rice tested over 33,000 children with a list of words (50 for the fourth and fifth-year classes, 75 for the sixth, seventh, and

eighth). He also examined the spelling of many of these in the case of compositions written on the basis of a story prepared for the purpose. The following were the words used in the two tests: —

Fourth and fifth-year test: running, slipped, listened, queer, speech, believe, weather, changeable, whistling, frightened, always, changing, chain, loose, baking, piece, receive, laughter, distance, choose, strange, picture, because, thought, purpose, learn, lose, almanac, neighbor, writing, language, careful, enough, necessary, waiting, disappoint, often, covered, mixture, getting, better, feather, light, deceive, driving, surface, rough, smooth, hopping, certainly.

Additional words for higher test: grateful, elegant, present, patience, succeed, severe, accident, sometimes, sensible, business, answer, sweeping, properly, improvement, fatiguing, anxious, appreciate, assure, imagine, peculiar, character, guarantee, approval, intelligent, experience, delicious, realize, importance, occasion, exceptions, thoroughly, conscientious, therefore, ascending, praise, wholesome.

Words omitted in higher test: because, thought, writing, language, feather, light, surface, rough, smooth.

These words were included in sentences dictated to the children, e.g., "While running he slipped. I listened to his queer speech, but I did not notice any of it."

The following table, adapted from Table No. 2 of Dr. Rice's account, gives the percentages of words correctly spelled, in connection with other data:

AVERAGES FOR INDIVIDUAL SCHOOLS

City	School	4th Year			5th Year			6th Year			7th Year			8th Year			School Av., Sentence-Test	City	School
		Sentence-Test	Composition-Test	Minutes Daily	Sentence-Test	Composition-Test	Minutes Daily	Sentence-Test	Composition-Test	Minutes Daily	Sentence-Test	Composition-Test	Minutes Daily	Sentence-Test	Composition-Test	Minutes Daily			
1	A	67.6	—	—	79.6	—	45	77.2	—	20	76.7	—	25	—	—	—	77.1	1	A
1	B	—	—	—	—	—	—	—	—	—	—	—	—	82	—	—		1	B
1	C	61.8	96.8	50	72.6	97.4	50	77.7	98.8	50	—	—	40	86.1	99.6	20	75	1	C
7	A	71	96.7	45	81.8	98.4	35	71.5	98.2	40	78	98.7	30	85.8	99	30	77.6	7	A
		B 77	95.9	30	73.6	97.8	20	64.2	97.8	20	73.1	—	—	84.9	—	30			
		A 68.6	97.5	40	79.4	98.3	15	73.4	98.6	40	—	99.4	40	—	99.4	35	75.2		
7	B	B 64.5	97	—	75	—	30	71.1	—	45	77.2	—	30	87.2	99.4	—		7	B
		A 75.8	97.9	20	81.1	—	40	80	—	50	81.1	—	15	86.7	99.3	30	77.9		
7	C	B —	97.5	—	—	97.6	—	—	97.8	35	—	98.7	—	—	99.4	15		7	C
		A —	97.4	35	—	98.6	15	—	99.1	45	—	99.2	30	—	—	—	—		
9	A	B 70.8	—	—	71.3	—	—	66.5	—	—	85.6	—	—	—	—	—		9	A
		A 66.6	—	40	78	—	—	72.8	—	35	—	—	50	—	—	—	76.6		
9	B	B 66.4	96.1	—	74.8	97.6	—	73.2	98.7	35	—	99.4	—	—	—	—		9	B
		A 68.4	96.8	—	76.8	97.9	45	75.1	98.4	45	86.5	99.2	60	—	—	—	77.7		
9	C	B 66	—	—	70	—	—	76.1	—	40	—	—	—	—	—	—		9	C
		A 66.4	—	40	83.2	—	—	79.4	—	35	84.7	—	20	—	—	—	77.9		
10	A	B —	—	—	—	—	—	—	—	—	80	99.2	—	83.5	99.2	—		10	A
		A —	—	—	—	—	—	—	—	—	79.5	98.6	20	82.5	99.1	20	76.2		
10	B	B 61.4	96.6	—	76.6	98.6	—	72.7	99.2	—	—	—	—	—	—	—		10	B
		A 75.9	98.3	35	77.2	98.9	20	—	—	20	—	—	—	—	—	—	—		
11	A	B 61.2	—	—	70.4	—	—	63.4	—	—	—	—	—	—	—	—		11	A
		A 63.6	—	25	70.6	—	—	65.8	—	25	76	—	30	86.4	—	40	72		

Small B indicates first half, and small A second half, of school year.

AVERAGES FOR INDIVIDUAL SCHOOLS (*Continued*)

City	School	4th Year			5th Year			6th Year			7th Year			8th Year			School Av., Sentence-Test	City	School
		Sentence-Test	Composition-Test	Minutes Daily	Sentence-Test	Composition-Test	Minutes Daily	Sentence-Test	Composition-Test	Minutes Daily	Sentence-Test	Composition-Test	Minutes Daily	Sentence-Test	Composition-Test	Minutes Daily			
11	B	B 76.4	96.3	—	74.6	97.9	—	74	98.5	—	—	—	—	—	—	—			
		A 79.8	97.9	35	81.8	98.5	25	—	—	30	80	98.8	40	86.7	99.1	40	79.4	11	B
12	A	B 53.2	—	—	66.4	—	—	75	—	—	—	—	—	86.3	—	—			
		A 63.1	—	—	73	—	—	75.7	—	—	78.3	—	—	90.2	—	—	73.9	12	A
12	B	B 53.3	—	—	74.4	—	18	73.1	—	—	—	—	—	90.3	—	—			
		A 67.2	—	18	79	—	10	78.4	—	9	90	—	12	94.6	—	12	79.0	12	B
15	B	B —	—	—	73	96.8	—	57	97.7	—	76.7	98.3	—	83.9	99	—			
		A —	—	—	73.4	97.4	—	71.5	98.1	—	83.3	98.7	—	87.2	99.4	—	73.4	15	B
15	D	B —	—	—	81.6	—	—	68.3	—	—	74.7	—	—	86.2	—	—			
		A 74.3	—	20	83.6	—	20	72.7	—	20	84	—	20	88.6	—	20	78.8	15	D
15	E	B 66.2	97	—	74.4	97.8	—	72.8	98.5	—	—	—	—	—	—	—			
		A 70.8	96.6	15	79.4	98.3	20	69.6	98.1	20	80.6	98.7	20	89.4	99.2	20	77.3	15	E
15	H	B 67.2	—	—	76.2	—	—	69.8	—	—	81.4	—	—	89.9	—	—			
		A 69.1	—	20	79.1	—	25	76.2	—	25	—	—	25	89.4	—	25	77.9	15	H
16	A	B 62.6	97.4	—	73.6	98.5	—	61.9	97.6	—	71.1	98.2	—	84	99.1	—			
		A 59.2	97.9	20	76.4	98.6	15	68.7	98.7	20	72.8	98.8	20	89.9	99.4	6	72.0	16	A
16	B	B 68.4	—	—	70.6	98.5	—	—	98.1	—	71.3	98.5	—	81.2	98.9	—			
		A 65	97.9	20	74.4	98.2	20	—	97.7	15	75.3	99.3	10	80.2	99.2	5	72.7	16	B
19	A	B 61.8	—	—	66.8	—	—	68.8	—	—	78	—	—	84.3	—	—			
		A —	—	20	76.6	—	40	72	—	35	84	—	—	—	—	—	73.8	19	A
19	B	B 57.4	—	—	73	—	—	61.3	—	—	69.5	—	—	85	—	—			
		A 68.4	—	40	78.2	—	—	69.5	—	30	84	—	30	86.8	—	—	73.3	19	B

Small B indicates first half, and small A second half, of school year.

[Of the facts summed up in it Dr. Rice writes as follows:]

"In the vast majority of instances the results are very close when the averages for entire buildings are compared. In fifteen of the twenty-one schools on my list, the averages on the second test, as the table shows, run from 73.3 to 77.9. Second, while the results in the lower grades of different schools show considerable variation, those in the eighth-year classes, which represent the end of the school course, are remarkably even. In twelve of the seventeen eighth-year grades the averages are from 84 to 88, the A and B classes being taken together. And in fifteen of a total of twenty sets of eighth-grade compositions examined for spelling, the variations were only three-tenths of one per cent, the results lying between 99.1 and 99.4, the A's and B's being taken as one. These facts are doubly remarkable when we consider that the twenty-one schools not only represent institutions in many sections of the country, but that they are samples of schools conducted under all conceivable conditions. For example, No. 7 is a Western city of moderate size, while No. 15 is a large city in the East. Again, most of the children attending School A, No. 7, are of American parentage, and their home surroundings are particularly favorable, while the children attending School B, No. 7, represent the foreign laboring element. Further, from a pedagogical standpoint, all varieties of schools are included; some of them belonging to the most mechanical, while others are among the most progressive in our country.

"If the best results had been secured in the mechanical and the poorest in the progressive schools, the question would arise, whether the small additional return would warrant the latter in placing additional pressure on spelling at the expense of other subjects. But even this question does not arise; for it did not happen that the results in most cases were best in mechanical schools. Indeed, in both the mechanical and the progressive schools the results were variable; so that while, in some instances, the higher figures were secured by the former, in others they were obtained by the latter; and the same is true of the lower figures. For example, School B, No. 11, in which the best average (79.4) was obtained, belongs to a very progressive system; while School A, No. 12, which made only 73.9, belongs to one of our most mechanical systems. And it is a peculiar incident that, in both these cities, the results in the only other school examined are exactly reversed, although the environment is about the same.

"Further, just as it is impossible by the results to distinguish the mechanical from the progressive schools, so it is impossible to distinguish the schools attended by the children of cultured parents from those representing the foreign laboring element; the results from this standpoint also varying equally. Consequently, so far as spelling is concerned, the influence of environment appears to be insignificant.

"The second point to which I have referred, namely, the small variation in the eighth-year results, — regardless of how much time had been devoted to spelling, or what methods had been employed, or under what home influences the children had been reared, — is also well worthy of consideration. And it is no less striking that the same level was reached in the end, regardless of what had been accomplished in the lower grades,

— a fact which becomes obvious on comparing the results in the eighth-year classes with the average obtained by the entire school. In the composition-test, where the results in fifteen of the twenty sets of eighth-year papers were within three-tenths of each other, this fact is still more clearly demonstrated.

* * * * * * * *

"Finally, as in most localities the general results were nearly equal — those secured under the same system of instruction varying as much as those obtained under different systems — it is clear that the remedy does not lie in a change of method, nor in an increase of time. And this conclusion accords with the fact that the dissatisfaction with spelling is as great in communities where this subject constitutes a special feature as in those where spelling plays only a subordinate part in the schools."

[The reader will note that the results were just as good in the case of schools devoting 15 or 20 minutes to spelling as in the case of those giving 40 or 50.]

[Dr. Rice also tabulated his results, or representative samples of them, so as to show more clearly the influence of age, intelligence (according to the teachers' opinions) and home environment. The following are those parts of his tables referring to the sentence-tests:]

TABLE NO. 1

		Fourth Year			Fifth Year			Sixth Year			Seventh Year			Eighth Year		
	City	Age	No. of Pupils	Genl. Average	Age	No. of Pupils	Genl. Average	Age	No. of Pupils	Genl. Average	Age	No. of Pupils	Genl. Average	Age	No. of Pupils	Genl. Average
Sentence-Test	1	9–11	72	69.5	10–12	56	81.6	12–13	22	79.9	12–14	43	76.7	12–14	35	86.9
	1	12–15	39	59.1	13–15	38	78.8	14–16	10	68.3	15–17	21	77.8	15–17	52	84.9
	*7	8–10	47	68.9	10–12	56	81.4	12–13	22	79.2	12–14	43	76.6	12–14	35	87.2
	*7	11–13	27	59.	13–15	38	78.9	14–16	10	68.3	15–17	21	77.8	15–17	52	84.8
	†9	9–11	55	70.2	10–12	38	75.5	11–13	38	73.1	12–14	44	86.2			
	†9	12–15	51	64.7	13–15	45	76.2	14–16	55	74.7	15–17	32	86.5			

* School A. † School B.

TABLE NO. 2

No. of Cities	Grade	No. of Classes	No. Pupils Intellect 1	Average	No. Pupils Intellect 2	Average	No. Pupils Intellect 3	Average	No. Pupils Intellect 4	Average
3	4	16	112	78.7	169	70.5	152	58.8	54	52.1
3	5	16	117	86.	239	77.7	165	71.1	59	61.6
3	6	23	164	88.7	263	84.3	182	78.	69	73.7
3	7	19	116	93.4	216	88.3	155	77.5	59	79.2
2	8	8	56	94.	99	89.3	97	87.8	20	81.5

TABLE NO. 3

	Grade	No. of Cities	No. of Classes	No. of Pupils	General Average	Children of Foreign Parentage	Average	No. of Children hearing Foreign Language at home	Average	Children of Unskilled Laborers	Average
Sentence-Test	Fourth	4	27	821	64.7	155	65.2	159	64.9	129	62 5
	Fifth	4	29	829	76.	153	77.4	157	76.7	129	74.5
	Sixth	4	22	778	69.7	185	69.6	165	70.3	119	70.4
	Seventh	4	18	566	78.8	81	82.5	52	81.5	55	76.8
	Eighth	4	19	528	83.1	72	83.2	64	83.2	76	85.

An examination of these tables will show (1) that within the same grade the younger pupils do better, presumably because they are brighter; (2) that success in spelling is correlated with intelligence in the teacher's estimation; (3) that home reading, refined companionship, English rather than foreign associations play no part in causing good spelling.

Dr. Rice further tabulated the results in accordance with the methods of instruction used in the different schools, interviewing some two hundred teachers for that purpose. He does not give the detailed results, but assures us that there is no reason to believe that there is any clear choice between oral and written spelling, writing isolated words and writing sentences, the sight or flash method and its absence. Phonic reading does not make bad spellers, nor do written language work and wide general reading make good spellers. "In brief," says he, "there is no direct relation between method and results. . . . The results varied as much under the same as they did under different methods of instruction."

There is a value to this study besides its information concerning methods of teaching spelling. It teaches the fallibility of judgments based on individual experience, the specious character of many of the most plausible arguments; it teaches also that the enthusiasm and mother-wit of the teacher may make a method seem good which is no better than others, that those of us who spend our time in talking about teaching are often talking so far above and off the stratum of fact that our dicta are vain, and, last but not least, that many of our quarrels are probably about matters which really don't make any difference. If the

scientific study of children did no more than teach these lessons to its followers it would still be an invaluable force in education.

If we may permit ourselves to criticise so good a piece of work as Dr. Rice's we may add another lesson gained from a possible mistake of his own. When Dr. Rice found that the evidence proved that none of the alleged factors made any difference in the spelling product, he dropped science, allowed himself to speculate, and said: "The facts here presented, in my opinion, will admit of only one conclusion, viz., that the results are not determined by the methods employed, but by the ability of those who use them. In other words, the first place must be given to the personal equation of the teacher, while methods and devices play a subordinate part."

Dr. Rice's desertion of facts for opinion was hasty, for there are real causes for good and bad spelling other than the one he opines. Miss E. K. Carmen, at my suggestion, tested the hypothesis that chronic bad spelling was due to comparative failure to observe and attend to the spelling of words, to the habit of reading without really seeing words in detail. From the report of her study I will quote a part. It appeared in the *Journal of Pedagogy* for October, 1900.

> That poor spelling occurs among people mentally incapacitated, or of slight education, or in young children with poor vision, is not surprising; but that it prevails among people completely endowed, and with the best educational advantages, presents something of an anomaly.
>
> It has seemed to me that poor spelling is due to poor observation; that is, observation *of the words* themselves,[1] and I have lately taken some

[1 Miss A. E. Wyckoff noted in a somewhat indefinite way this same fact, but seems to refer it to a quality of attention in general rather than to a particular habit of attending to words. She wrote (*Pedagogical Seminary*, Vol. II, p. 450): "Constitutional bad spelling may, in part, be the result of a strong natural bent toward selective attention." Her data were observations of two bad spellers, of whom she says, "Conspicuous as thinkers, they were comparatively slow readers, having the habit of reading one word at a time. Almost all their mistakes in spelling occurred in the latter half of the word. . . . Further tests made it clear that attention was habitually directed to the beginning of the words. Here, then, seemed to be one type of constitutional bad speller proved by subsequent tests to have good powers of

pains to test this theory. The people taken for the experiments were sixteen adults, all of whom, in addition to having completed a high-school course, had spent, on an average, two years more in study. These comprised eight good spellers and eight poor ones. This fact was assured in some cases by the persons' own word for it, in others by evidence from daily work at college during the present year. In either case, if there was any doubt, dictation was given them for this purpose.

To them was given the following printed page from Appleton's Fourth Reader, containing one hundred mis-spelled words. They were asked to go through the paper as quickly as possible, marking each mis-spelled word:

MARK EVERY WORD THAT IS NOT SPELLED CORRECTLY

1. On the 3d of September, 1832, inteligence was broght to the collecter of Tinnevelly that som wildd eliphants had appeared in the neighborhod. A hunting party was imediately formed, and a large number of nattive hunters were engaged. We left the tents, on horsback, at half-past sevin o'clock in the morrning and rode thre miles to an open spote, flanked on one sid bye Rice-fields, and on the other by a jungle.

2. After waiting som time, Captain B——— and myself walked acros the rice-fields to the shad of a tree. There we herd the trumpett of an elephant; we reshed acros the rice-fields up to our knes in mud, but all in vaiu, thogh we came upon the trak of one of the animels, and then ran five or six hundredd yards iutoo the jungle.

3. After varius false allarms, aud vane endevors to discuvor the obgects of our chace, the colector went into the jungle, and Captin B——— and myself into bed of the stream' where we had sen the traks; and here it was evedent the elaphents had passed to and fro. Disapointed and impasient, we allmost determened to giv up the chace and go home; but shots fird just before us reanimated us, aud we proceded, and found the collecter had just firred twicce.

4. Of we went throuh forest, over ravin, and through strems, till att last, at the top of the ravine, the eliphants were seen. This was a momant of excitment! We wer all scatered. The collecter had taken the midle path; Captain B———, some huntsmen, and myself took to the feft; and the other hunters scrabled down that to the rite. At this momunt I did not see enything but after advanceing a few yards, the hugh hed ef an elephunt shaking abuve the jungle, withen ten yards of us, burst sudenly upon my view.

5. Captain B——— ande a hunter justt befor me; we al fired at the same moment, and in so dirrect a line that the percussion cap of my gun hitt the hunter, whome I thougt at first I had shoot. This acident, thogh

visualization and sound imaging and fair retention, but gifted with a natural mode of attention unsuited to purposes of spelling." — E. L. T.]

it prouved slight, troubled me a litle. The grate excitment ocasioned by seeing, for the first tim, a wild best at liberty and in a state of natur, product a sensation of hop and fear that was intens.

The time of each in marking the words was accurately recorded. The averages ran thus:

	Time—Seconds	Word Omitted
Good spellers	130.1	8.9
Poor "	199.6	28.1

Note. — The average deviation in time taken by the good spellers was ± 50.6 seconds; by the poor spellers, ± 62.8. The average deviation in the number of words omitted by the good spellers was ± 3.9; by the poor spellers, ± 12.9.

One of the poor spellers, B, who was in other respects rather an exceptional case, made a record of time taken, 112 seconds, and words omitted, 64.

If we take the remaining seven as representative of poor spellers, we find the average time to be 212.1 seconds, with an average deviation of ± 59.4 seconds, while the average number of words omitted is 23, with an average deviation of ± 9.6.

The test was applied to blind people, whose observation is tactual. The same page was reproduced in point and given to four good spellers and two poor ones among the pupils at the Indianapolis Institute for the Blind.

The records are given complete:

Good Spellers	Time min.	sec.	Words Omitted
1. Eighth grade—congenital	8	10	31
2. Eighth grade—blind at 2 years	11		26
3. Graduate—blind at 4 years	11	30	21
4. Seventh grade—blind at 4 days	5		57
Poor Spellers			
5. Seventh grade—blind at 6 years	11	20	66
6. Senior—blind at 2 years	12	5	55

Note. — Of course, with most people reading with the fingers requires a great deal more time than with the eyes.

The averages are:

	Time—min.	sec.	Words Omitted
Good spellers . . .	8	55	33.7
Poor " . . .	11	42.5	60.5

The fourth person here is also exceptional, and the average without this one is: time, 10 minutes 12 seconds, and words omitted, 26.

Of course, as the number of cases is so small, these averages cannot pretend to represent good and poor spellers in general. They are inserted merely as a clearer representation of the table in the text.

After the marking of words there were made with the sixteen, other tests of observation, as follows:

They were given printed pages that were similar, on which to mark, as quickly as they could, all words containing two given letters: in the first set s and p, the second l and o, the third e and v. The averages were:

	Time (to page)	Omissions (to page)
Good spellers . . .	99.7 sec.	3.6
Poor " . . .	134.7 "	6.2

Note. — The average deviation in time taken by the good spellers was ± 28.1 seconds, by the poor spellers, ± 26.2 seconds.

The average deviation in the number of omissions by the good spellers was ± .8, by the poor spellers, ± 1.9.

Leaving out again the record of case B, the poor spellers have an average time to the page of 136.5 seconds, with an average deviation of ± 29 seconds, while the average number of omissions is 5.6, with an average deviation of ± 1.8.

The next test was with two cards containing each ten letters of various sizes, and irregularly placed. These were exposed to them for five seconds, after which they wrote as many of the letters as they could.

The average mistakes were, for the good spellers, 6.6; for the poor ones, 8.2.

Note. — The average deviation for good spellers was ± 3.65, and for poor ones, ± 4.7. Omitting case B, the poor spellers had an average of 7 mistakes, with an average deviation of ± 4.1.

The last test consisted of four cards on which were forms, such as triangles, circles, squares, lines parallel and otherwise, and some figures of undefinable shape. These were also exposed for five seconds, after which they were to be drawn upon paper. The average mistakes were: for the good spellers, 11; for the poor ones, 11.6.

Note. — The average deviation for good spellers was ± 2.2, and for the poor ones, ± 3.6. Omitting case B, the poor spellers had an average of 10.7 mistakes, with an average deviation of ± 3.2.

By noticing the results of the three tests given for observation in other things than words, we see a decrease of the difference in observational ability between the two classes as the data to be observed become more and more unlike words. Ability to spell well, therefore, probably implies not a *general* habit or power of observation, but a *special* ability to notice small differences in *words*.

Whether any specific methods can be used in the class-room to secure the habit of attention to the spelling of words during reading is still a question. It would seem likely.

CHILD STUDY REPRINTS

THE ATTITUDE OF CHILDREN TOWARD PUNISHMENT

The control of children depends partly on a concrete practical comprehension of their make-up, their reaction to different sorts of incentives and deterrents, their appreciation of laws, rules, advice, and so forth. The study of children may provide data which may increase a teacher's general information about this side of child life and so assist to the concrete, practical comprehension or tact ultimately necessary in dealing with matters of discipline and moral education. A number of studies have attempted to do this with greater or less success. One of the most interesting of their conclusions concerns the existence in young children of an overwhelming tendency to regard the letter rather than the spirit of laws, to look on justice not as equity, but as a fate overtaking certain definite transgressions; to regard punishments not as remedial or preventive agencies, but as natural results of certain acts, regardless of intentions. This attitude comes out clearly in the following characteristic account of boy justice, taken from Mr. John Johnson, Jr.'s excellent study, *Rudimentary Society Among Boys.*[1] Mr. Johnson studied the social habits of the boys living together in an institution possessed of eight hundred acres of land and quite isolated from outside influences. The study, as a whole, is well worth reading.

Disputes arising from their peculiar customs of ownership are settled by boys assembled at the place where the controversy is carried on. Most commonly this is in the play-room, where they can be free from observation. When Black and Landreth found the nest of a dove in the pines, seeing no mark of prior owners upon the tree, they took the eggs and brought them to the house. As they sat in the play-room, with needles and straws, preparing the eggs for their cabinet, Delphey overheard their talk, and questioned them about the spot where the nest was discovered. He soon con-

[1] Johns Hopkins Press.

vinced himself that the nest was one that he had found but a few days before, and on which he had placed the mark of himself and his partners. When he was satisfied on that point, he at once laid claim to the eggs. Landreth and Black angrily refused to give them up, and they were soon hot in dispute. Under the law made for such cases, the question of ownership is a nice one. It is granted on both sides that if Delphey, the first finder, is to retain a good title, his label must either remain upon the trunk of the tree, or else lie in sight upon the ground beneath, where it has fallen by accident. If neither alternative is complied with, any subsequent finder may either take the nest or mark the tree with his own label.

By this time a knot of a dozen boys, who had been idling about, had formed around Delphey, listening intently. In a few moments he called Duvall, his partner, for confirmation, and with the utmost particularity related the circumstances in which he had found the nest. Delphey told of the route they took over the stream, through the swamp, and up the hill, and mentioned the boys they met on the way, whom he compelled to corroborate his assertions. By the time Duvall takes up the account, the ring surrounding them has become larger; perhaps twenty boys have gathered, and they listen with strained attention. He proceeds to describe the tree in which the nest was placed, and dwells with convincing minuteness upon its exact situation, upon the color of the bark, the broken limb, the knot half-way up the trunk, and the nailing of the label upon it. To all of his statements it may be that his adversaries, Landreth and Black, assent, only interjecting at intervals the words: "But there wasn't any mark on the tree when we were there." The declarations of either party are addressed as much to the throng around as to their opponents, and it is evident, in the heightened color of the bystanders, in their sparkling eyes, and in their tense muscles, that to them the question is of absorbing interest. Now that the argument of the plaintiffs has been heard in full, there can be no doubt that they marked the nest as they declare; and yet there is nothing to indicate that the defendants have any intention of restoring the property.

Seeing the angry looks and threatening gestures of all the group, one who does not know the school may judge that blows will follow next, and that a general conflict is about to ensue between the partisans of the claimants. Nothing could be farther from the truth. What has occurred is but the ordinary proceeding of a very primitive court of justice. Delphey knows that Black's arms are strong, his fists hard, and his blows rapid. Landreth has no desire to risk the destruction of his treasure in a struggle where, even if he retains it, he is sure to do so at the cost of bruises and blood. As he rises angrily from his seat and pushes through the crowd, he is not seeking space in which to fight, but a witness to establish his title. This body of spectators, who seem intent upon hearing the whole matter and sifting it to the bottom, is — if the name will serve — the folk-moot, the assembly of the people, met to see justice done according to law. Each boy standing in the ring around the orators knows that to-morrow he may be there to maintain his rights before a similar body, in which the plaintiff and the defendant of to-day will alike have

a voice to decide upon his claims. He has a feeling that a decision contrary to established custom, however it may accord with his momentary sympathies, will be treated as a precedent to overthrow his most cherished interests and to prevent the operation of rules upon which he had confidently counted in every venture in which he is engaged. Every boy there is determined upon the entire preservation of the system of law upon which he has based all his hopes of filling his egg-cabinet.

We have turned aside a moment from following the actions of the litigants. The clamor of voices rose louder as Landreth moved off, but it subsided somewhat as he reappeared, accompanied by Miller, on whose testimony he relied. The newcomer rapidly explained to those around that he, too, had seen the nest on the day Landreth took it; he had examined the tree, and Delphey's mark was not upon it; he had searched the ground beneath, and could not find the label there; he would himself have carried off the find but for the fact that he saw only a single egg, and thought it better to put his own claim-mark upon the trunk and wait till more eggs were laid, when he had intended to return and get them. It had happened, however, that during his previous search for nests he had, in marking other discoveries, used up all the labels that he had brought with him, and he had, therefore, been unable to appropriate the tree at the time. It was after he had gone away, and before he could return with a label, that Landreth had found the nest and possessed himself of its contents, which had, meanwhile, been increased to two eggs by the industrious bird.

This evidence ended the trial. Loud cries arose from all parts of the throng. "It's Doggie's nest. It wasn't marked when he found it," said one member of the tumultuous court. "Your mark was blown away, Rufie," exclaimed another; "it's Doggie's nest." No opposition of importance was made, and, the decision being rendered, Delphey and his partner saw their case was lost, and slowly walked away. Landreth and Black, who retained the eggs, returned to their work of blowing them with straws. The making of the claim, the trial, and the decision, occupied less than half an hour. If not sure, this justice is at least swift.

A word may here be given to the ethical questions brought up by this decision. It was admitted by all parties that the two boys had found the nest before Landreth and Black had seen it. Landreth's claims, in the view of equity, would have to yield to Delphey's, who not only found the nest, but marked it, and who, in so far as prior discovery gives any rights, clearly had them all. Landreth's title rested upon a purely technical ground. Yet, with a characteristic analogy to primitive habits of thought, it was considered that the perfect title was obtained by a literal fulfilment of the words of the law, by an exact compliance with its minutest provisions. The law provided that no one should take a nest when the mark was on the trunk beneath or in sight upon the ground. As it had been proved by Miller's testimony that Landreth could not have seen Delphey's label, Delphey's rights vanished.

There can be little doubt that the negligent driving of a tack was all that made Landreth the better owner than Delphey, and that Landreth

was perfectly aware of this fact. When the suitors and judges were questioned as to why such a decision was given, the only reply to be obtained was, "That's the rule." Like Shylock, Landreth might have said: "I stand here for law," and his determination was to maintain to the full every legal privilege. The idea that the law might give advantages the use of which morality could not sanction, is so late a development in the legal history of mankind that we must not regard the absence of such a conception among these boys as an indication of an abnormally low state of moral culture. To look for exalted views of right and wrong among them would be to expect them to reverse the usual processes of mental progress.

John Johnson, Jr., *Rudimentary Society Among Boys*, pp. 36-40.

With this sample of boy justice we may compare one of the results of a study by Miss Margaret E. Schallenberger, reported in full on pages 87–96 of the *Pedagogical Seminary*, Vol. III, entitled "A Study of Children's Rights, as Seen by Themselves." About 3000 children wrote a language lesson after being read the following statement and question:

"Jennie had a beautiful new box of paints, and in the afternoon, while her mother was gone, she painted all the chairs in the parlor, so as to make them look nice for her mother. When her mother came home, Jennie ran to meet her, and said, 'Oh, mamma, come and see how pretty I have made the parlor;' but her mamma took her paints away and sent her to bed. If you had been her mother, what would you have done or said to Jennie?"

Their answers were classified under the following heads:

1. Ignorant.
2. Explained to.
3. Don't do it again.
4. Made to promise.
5. Threatened.
6. Scolded.
7. Clean chairs.
8. Confined.
9. Lose meal.
10. Lose paints.
11. Sent to bed.
12. Whipped.
13. Punished.
14. Peculiar punishments.

Replies 1, 2, 3 and 4 testify roughly to a sense of equity, of consciousness of intention as the criterion of good or bad, while 8, 9, 10, 11, 12, 13 and 14 show, again roughly, the tendency to regard punishment as retaliation or as a fate overtaking certain acts, regardless of the intention that produced them. As children grow older the first sort of replies increase, while the second sort decrease. From the detailed table given by Miss Schallenberger I reckon the percentages for the different ages to be as follows:

	Years,	6	7	8	9	10	11	12	13	14	15	16
Boys	Retaliation or Fate	87.5	80.9	80.	84.	77.	75.	73.	67.	49.	49.	33.
	Equity	8.	9.	7.	9.	12.	9.	14.	16.	32.	36.	59.
Girls	Retaliation or Fate	92.5	82.5	81.	70.	67.	64.	60.	55.	49.	37.	36.
	Equity	3.	9.	9.	10.	17.	21.	24.	33.	36.	48.	49.

The following quotation from Miss Schallenberger states the general fact shown by the figures:

Almost as striking as children's reasons for punishment are their attitudes regarding the motive that lies back of the action. The intellectual and moral condition of a man can be fairly estimated by his ability and willingness to judge of the motives which actuate those about him. A marked difference in children regarding motives is noticeable.

The young child thinks of the result of an action. If the result is bad, punishment should follow; if not, the offender should be allowed to go free. A ten-year-old boy writes: "If the girl made the chairs nicer than they were, I would tell her that she was a good girl; and if she soiled the chairs, I would give her a whipping." A little girl voices the opinion of many another when she says: "If I were her mother, I would have whipped her for spoiling the parlor chairs."

Another one, nine years old, seems to us wise elders inconsistent when she writes: "Jennie thought that she was making the chairs pretty. But she spoilt the chairs. I would have taken her and I would whipped her and sent her to bed for the rest of the day. I would told her that she was a bad little girl."

Equally regardless of good intention is the statement of the child who says: "I would whip her and send her to bed out any supper"; and then adds, as if it were of no importance, "Jennie thought it would make her mother glad."

The older children, on the contrary, think of the motive that led to the action. If this be good, punishment should be light or not at all. Sometimes, because of this feeling, they grow indignant over the treatment of Jennie by the mother in the story.

HEREDITY AND ENVIRONMENT

The great importance to educational theory of knowledge concerning the relative influence of what our natures are at birth and what our education is afterward contrasts with its small amount. How far our course in life is determined for us before we start by the organizations we are born with is one of the first problems of educational theory, a problem concerning which speculation and opinion too often run riot.

One of the few really earnest and hopeful attempts to answer this question is Mr. Francis Galton's "Study of Twins," an account of which is found in his *Inquiries into Human Faculty* (London, 1883) and which is here reprinted in full. This study is very valuable, and, unfortunately, very inaccessible; it may also serve as a sample of the careful investigation of the fundamental laws of mental inheritance for which educational science owes Galton a great debt; it will do its best service if it introduces the reader to the general treatises on heredity of Galton and Karl Pearson or induces him to collect data concerning heredity from his own neighborhood.

HISTORY OF TWINS

Pages 216–243 of *Inquiries Into Human Faculty*

The exceedingly close resemblance attributed to twins has been the subject of many novels and plays, and most persons have felt a desire to know upon what basis of truth those works of fiction may rest. But twins have a special claim upon our attention; it is, that their history affords means of distinguishing between the effects of tendencies received at birth and of those that were imposed by the special circumstances of their after-lives. The objection to statistical evidence in proof of the inheritance of peculiar faculties has always been: "The persons whom you compare may have lived under similar social conditions and have had similar ad-

vantages of education, but such prominent conditions are only a small part of those that determine the future of each man's life. It is to trifling accidental circumstances that the bent of his disposition and his success are mainly due, and these you leave wholly out of account — in fact, they do not admit of being tabulated, and therefore your statistics, however plausible at first sight, are really of very little use." No method of inquiry which I had previously been able to carry out — and I have tried many methods — is wholly free from this objection. I have therefore attacked the problem from the opposite side, seeking for some new method by which it would be possible to weigh in just scales the effects of Nature and Nurture, and to ascertain their respective shares in framing the disposition and intellectual ability of men. The life-history of twins supplies what I wanted. We may begin by inquiring about twins who were closely alike in boyhood and youth, and who were educated together for many years, and learn whether they subsequently grew unlike, and, if so, what the main causes were which, in the opinion of the family, produced the dissimilarity. In this way we can obtain direct evidence of the kind we want. Again, we may obtain yet more valuable evidence by a converse method. We can inquire into the history of twins who were exceedingly unlike in childhood, and learn how far their characters became assimilated under the influence of identical nurture, inasmuch as they had the same home, the same teachers, the same associates, and in every other respect the same surroundings.

My materials were obtained by sending circulars of inquiry to persons who were either twins themselves or near relations of twins. The printed questions were in thirteen groups; the last of them asked for the addresses of other twins known to the recipient, who might be likely to respond if I wrote to them. This happily led to a continually widening circle of correspondence, which I pursued until enough material was accumulated for a general reconnaisance of the subject.

There is a large literature relating to twins in their purely surgical and physiological aspect. The reader interested in this should consult "Die Lehre von den Zwillingen," von L. Kleinwächter, Prag, 1871. It is full of references, but it also is unhappily disfigured by a number of numerical misprints, especially in page 26. I have not found any book that treats of twins from my present point of view.

The reader will easily understand that the word "twins" is a vague expression, which covers two very dissimilar events — the one corresponding to the progeny of animals that usually bear more than one at a birth, each of the progeny being derived from a separate ovum, while the other event is due to the development of two germinal spots in the same ovum. In the latter case they are enveloped in the same membrane, and all such twins are found invariably to be of the same sex. The consequence of this is, that I find a curious discontinuity in my results. One would have expected that twins would commonly be found to possess a certain average likeness to one another; that a few would greatly exceed that average likeness, and a few would greatly fall short of it. But this is not at all the case. Extreme similarity and extreme dissimilarity between twins of

the same sex are nearly as common as moderate resemblance. When the twins are a boy and a girl, they are never closely alike; in fact, their origin is never due to the development of two germinal spots in the same ovum.

I received about eighty returns of cases of close similarity, thirty-five of which entered into many instructive details. In a few of these not a single point of difference could be specified. In the remainder, the color of the hair and eyes was almost always identical; the height, weight, and strength were nearly so. Nevertheless, I have a few cases of a notable difference in height, weight, and strength, although the resemblance was otherwise very near. The manner and personal address of the thirty-five pairs of twins are usually described as very similar, but accompanied by a slight difference of expression, familiar to near relatives, though unperceived by strangers. The intonation of the voice when speaking is commonly the same, but it frequently happens that the twins sing in different keys. Most singularly, the one point in which similarity is rare is the handwriting. I cannot account for this, considering how strongly handwriting runs in families, but I am sure of the fact. I have only one case in which nobody, not even the twins themselves, could distinguish their own notes of lectures, etc.; barely two or three in which the handwriting was distinguishable by others, and only a few in which it was described as closely alike. On the other hand, I have many in which it is stated to be unlike, and some in which it is alluded to as the only point of difference. It would appear that the handwriting is a very delicate test of difference in organization — a conclusion which I commend to the notice of enthusiasts in the art of discovering character by the handwriting.

One of my inquiries was for anecdotes regarding mistakes made between the twins by their near relatives. The replies are numerous, but not very varied in character. When the twins are children, they are usually distinguished by ribbons tied around their wrist or neck; nevertheless the one is sometimes fed, physicked, and whipped by mistake for the other, and the description of these little domestic catastrophes was usually given, by the mother, in a phraseology that is somewhat touching by reason of its seriousness. I have one case in which a doubt remains whether the children were not changed in their bath, and the presumed A is not really B, and *vice versa*. In another case, an artist was engaged on the portraits of twins who were between three and four years of age; he had to lay aside his work for three weeks, and, on resuming it, could not tell to which child the respective likenesses he had in hand belonged. The mistakes become less numerous on the part of the mother during the boyhood and girlhood of the twins, but are almost as frequent as before on the part of strangers. I have many instances of tutors being unable to distinguish their twin pupils. Two girls used regularly to impose on their music teacher when one of them wanted a whole holiday; they had their lessons at separate hours, and the one girl sacrificed herself to receive two lessons on the same day, while the other one enjoyed herself from morning to evening. Here is a brief and comprehensive account:

"Exactly alike in all, their schoolmasters could never tell them apart; at dancing parties they constantly changed partners without discovery; their close resemblance is scarcely diminished by age."

The following is a typical schoolboy anecdote:

"Two twins were fond of playing tricks, and complaints were frequently made; but the boys would never own which was the guilty one, and the complainants were never certain which of the two he was. One head-master used to say he would never flog the innocent for the guilty, and another used to flog both."

No less than nine anecdotes have reached me of a twin seeing his or her reflection in a looking-glass, and addressing it in the belief that it was the other twin in person.

I have many anecdotes of mistakes when the twins were nearly grown up. Thus:

"Amusing scenes occurred at college when one twin came to visit the other; the porter on one occasion refusing to let the visitor out of the college gates, for, though they stood side by side, he professed ignorance as to which he ought to allow to depart."

Children are usually quick in distinguishing between their parent and his or her twin; but I have two cases to the contrary. Thus, the daughter of a twin says:

"Such was the marvellous similarity of their features, voice, manner, etc., that I remember, as a child, being very much puzzled, and I think, had my aunt lived much with us, I should have ended by thinking that I had two mothers."

In the other case, a father who was a twin, remarks of himself and his brother:

"We were extremely alike, and are so at this moment, so much so that our children up to five and six years old did not know us apart."

I have four or five instances of doubt during an engagement of marriage. Thus:

"A married first, but both twins met the lady together for the first time, and fell in love with her there and then. A managed to see her home and gain her affection, though B went sometimes courting in his place, and neither the lady nor her parents could tell which was which."

I have also a German letter, written in quaint terms, about twin brothers who married sisters but could not easily be distinguished by them.[1] In the well-known novel by Mr. Wilkie Collins of "Poor Miss Finch," the blind girl distinguishes the twin she loves by a touch of his hand, which gives her a thrill that the touch of the other brother does

[1] I take this opportunity of withdrawing an anecdote, happily of no great importance, published in "Men of Science," p. 14, about a man personating his twin brother for a joke at supper, and not being discovered by his wife. It was told me on good authority; but I have reason to doubt the fact, as the story is not known to the son of one of the twins. However, the twins in question were extraordinarily alike, and I have many anecdotes about them sent me by the latter gentleman.

not. Philosophers have not, I believe, as yet investigated the conditions of such thrills; but I have a case in which Miss Finch's test would have failed. Two persons, both friends of a certain twin lady, told me that she had frequently remarked to them that "kissing her twin sister was not like kissing her other sisters, but like kissing herself — her own hand, for example."

It would be an interesting experiment for twins who were closely alike to try how far dogs could distinguish them by scent.

I have a few anecdotes of strange mistakes made between twins in adult life. Thus, an officer writes:

"On one occasion when I returned from foreign service, my father turned to me and said, 'I thought you were in London,' thinking I was my brother — yet he had not seen me for nearly four years — our resemblance was so great."

The next and last anecdote I shall give is, perhaps, the most remarkable of those I have; it was sent me by the brother of the twins, who were in middle life at the time of its occurrence:

"A was again coming home from India, on leave; the ship did not arrive for some days after it was due; the twin brother B had come up from his quarters to receive A, and their old mother was very nervous. One morning A rushed in saying, 'Oh, mother, how are you?' Her answer was, 'No, B, it's a bad joke; you know how anxious I am!' and it was a little time before A could persuade her that he was the real man."

Enough has been said to prove that an extremely close personal resemblance frequently exists between twins of the same sex; and that, although resemblance usually diminishes as they grow into manhood and womanhood, some cases occur in which the diminution of resemblance is hardly perceptible. It must be borne in mind that it is not necessary to ascribe the divergence of development, when it occurs, to the effect of different nurtures, but it is quite possible that it may be due to the late appearance of qualities inherited at birth, though dormant, in early life, like gout. To this I shall recur.

There is a curious feature in the character of the resemblance between twins, which has been alluded to by a few correspondents; it is well illustrated by the following quotations. A mother of twins says:

"There seemed to be a sort of interchangeable likeness in expression, that often gave to each the effect of being more like his brother than himself."

Again, two twin brothers, writing to me, after analyzing their points of resemblance, which are close and numerous, and pointing out certain shades of difference, add:

"These seemed to have marked us through life, though for a while, when we were first separated, the one to go to business and the other to college, our respective characters were inverted; we both think that at that time we each ran into the character of the other. The proof of this consists in our own recollections, in our correspondence by letter, and in the views which we then took of matters in which we were interested."

In explanation of this apparent interchangeableness, we must recollect that no character is simple, and that in twins who strongly resemble each other, every expression in the one may be matched by a corresponding expression in the other, but it does not follow that the same expression should be the prevalent one in both cases. Now it is by their prevalent expressions that we should distinguish between the twins; consequently when one twin has temporarily the expression which is the prevalent one in his brother, he is apt to be mistaken for him. There are also cases where the development of the two twins is not strictly *pari passu;* they reach the same goal at the same time, but not by identical stages. Thus: A is born the larger, then B overtakes and surpasses A, and is in his turn overtaken by A, the end being that the twins, on reaching adult life, are of the same size. This process would aid in giving an interchangeable likeness at certain periods of their growth, and is undoubtedly due to nature more frequently than to nurture.

Among my thirty-five detailed cases of close similarity, there are no less than seven in which both twins suffered from some special ailment or had some exceptional peculiarity. One twin writes that she and her sister "have both the defect of not being able to come downstairs quickly, which, however, was not born with them, but came on at the age of twenty. Three pairs of twins have peculiarities in their fingers; in one case it consists in a slight congenital flexure of one of the joints of the little finger; it was inherited from a grandmother, but neither parents, nor brothers, nor sisters show the least trace of it. In another case the twins have a peculiar way of bending the fingers, and there was a faint tendency to the same peculiarity in the mother, but in her alone of all the family. In a third case, about which I made a few inquiries, which is given by Mr. Darwin, but is not included in my returns, there was no known family tendency to the peculiarity which was observed in the twins of having a crooked little finger. In another pair of twins, one was born ruptured, and the other became so at six months old. Two twins at the age of twenty-three were attacked by toothache, and the same tooth had to be extracted in each case. There are curious and close correspondences mentioned in the falling off of the hair. Two cases are mentioned of death from the same disease; one of which is very affecting. The outline of the story was that the twins were closely alike and singularly attached and had identical tastes; they both obtained Government clerkships, and kept house together, when one sickened and died of Bright's disease, and the other also sickened of the same disease and died seven months later.

Both twins were apt to sicken at the same time in no less than nine out of the thirty-five cases. Either their illnesses, to which I refer, were non-contagious, or, if contagious, the twins caught them simultaneously; they did not catch them the one from the other. This implies so intimate a constitutional resemblance, that it is proper to give some quotations in evidence. Thus, the father of two twins says:

"Their general health is closely alike; whenever one of them has an illness, the other invariably has the same within a day or two, and they

usually recover in the same order. Such has been the case with whooping-cough, chicken-pox, and measles; also with slight bilious attacks, which they have successively. Latterly they had a feverish attack at the same time."

Another parent of twins says:

"If anything ails one of them, identical symptoms *nearly always* appear in the other; this has been singularly visible in two instances during the last two months. Thus, when in London, one fell ill with a violent attack of dysentery, and within twenty-four hours the other had precisely the same symptoms."

A medical man writes of twins with whom he is well acquainted:

"Whilst I knew them, for a period of two years, there was not the slightest tendency towards a difference in body or mind; external influences seemed powerless to produce any dissimilarity."

The mother of two other twins, after describing how they were ill simultaneously up to the age of fifteen, adds that they shed their first milk-teeth within a few hours of each other.

Trousseau has a very remarkable case (in the chapter on Asthma) in his important work, "Clinique Médicale." (In the edition of 1873 it is in Vol. II, p. 473.) It was quoted at length in the original French, in Mr. Darwin's "Variation under Domestication," Vol. II, p. 252. The following is a translation:

"I attended twin brothers so extraordinarily alike, that it was impossible for me to tell which was which, without seeing them side by side. But their physical likeness extended still deeper, for they had, so to speak, a yet more remarkable pathological resemblance. Thus, one of them, whom I saw at the Néothermes at Paris, suffering from rheumatic ophthalmia, said to me, 'At this instant my brother must be having an ophthalmia like mine'; and, as I had exclaimed against such an assertion, he showed me a few days afterwards a letter just received by him from his brother, who was at that time at Vienna, and who expressed himself in these words—'I have my ophthalmia; you must be having yours.' However singular this story may appear, the fact is none the less exact; it has not been told to me by others, but I have seen it myself; and I have seen other analogous cases in my practice. These twins were also asthmatic, and asthmatic to a frightful degree. Though born in Marseilles, they were never able to stay in that town, where their business affairs required them to go, without having an attack. Still more strange, it was sufficient for them to get away only as far as Toulon in order to be cured of the attack caught at Marseilles. They travelled continually, and in all countries, on business affairs, and they remarked that certain localities were extremely hurtful to them, and that in others they were free from all asthmatic symptoms."

I do not like to pass over here a most dramatic tale in the "Psychologie Morbide" of Dr. J. Moreau (de Tours), Médecin de l'Hospice de Bicêtre. Paris, 1859, p. 172. He speaks "of two twins brothers who had been confined, on account of monomania, at Bicêtre":

"Physically the two young men are so nearly alike that the one is

easily mistaken for the other. Morally, their resemblance is no less complete, and is most remarkable in its details. Thus, their dominant ideas are absolutely the same. They both consider themselves subject to imaginary persecutions; the same enemies have sworn their destruction, and employ the same means to effect it. Both have hallucinations of hearing. They are both of them melancholy and morose; they never address a word to anybody, and will hardly answer the questions that others address to them. They always keep apart, and never communicate with one another. An extremely curious fact which has been frequently noted by the superintendents of their section of the hospital, and by myself, is this: From time to time, at very irregular intervals of two, three, and many months, without appreciable cause, and by the purely spontaneous effect of their illness, a very marked change takes place in the condition of the two brothers. Both of them, at the same time, and often on the same day, rouse themselves from their habitual stupor and prostration; they make the same complaints, and they come of their own accord to the physician, with an urgent request to be liberated. I have seen this strange thing occur, even when they were some miles apart, the one being at Bicêtre, and the other living at Saint-Anne."

I sent a copy of this passage to the principal authorities among the physicians to the insane in England, asking if they had ever witnessed any similar case. In reply, I have received three noteworthy instances, but none to be compared in their exact parallelism with that just given. The details of these three cases are painful, and it is not necessary to my general purpose that I should further allude to them.

There is another curious French case of insanity in twins, which was pointed out to me by Sir James Paget, described by Dr. Baume in the "Annales Médico-Psychologiques," 4 série, vol. I, 1863, p. 312, of which the following is an abstract. The original contains a few more details, but too long to quote: François and Martin, fifty years of age, worked as railroad contractors between Quimper and Châteaulin. Martin had twice slight attacks of insanity. On January 15 a box was robbed in which the twins had deposited their savings. On the night of January 23-24 both François (who lodged at Quimper) and Martin (who lived with his wife and children at St. Lorette, two leagues from Quimper) had the same dream at the same hour, three A.M., and both awoke with a violent start, calling out, "I have caught the thief! I have caught the thief! they are doing mischief to my brother!" They were both of them extremely agitated, and gave way to similar extravagances, dancing and leaping. Martin sprang on his grandchild, declaring that he was the thief, and would have strangled him had he not been prevented; he then became steadily worse, complained of violent pains in his head, went out of doors on some excuse, and tried to drown himself in the river Steir, but was forcibly stopped by his son, who had watched and followed him. He was then taken to an asylum by gendarmes, where he died in three hours. François, on his part, calmed down on the morning of the 24th, and employed the day in inquiring about the robbery. By a strange chance, he crossed his brother's path at the moment when the latter was

struggling with the gendarmes; then he himself became maddened, giving way to extravagant gestures and using incoherent language (similar to that of his brother). He then asked to be bled, which was done, and afterwards, declaring himself to be better, went out on the pretext of executing some commission, but really to drown himself in the river Steir, which he actually did, at the very spot where Martin had attempted to do the same thing a few hours previously.

The next point which I shall mention in illustration of the extremely close resemblance between certain twins is the similarity in the association of their ideas. No less than eleven out of the thirty-five cases testify to this. They make the same remarks on the same occasion, begin singing the same song at the same moment, and so on; or one would commence a sentence and the other would finish it. An observant friend graphically described to me the effect produced on her by two such twins whom she had met casually. She said: "Their teeth grew alike, they spoke alike and together, and said the same things, and seemed just like one person." One of the most curious anecdotes that I have received concerning this similarity of ideas was that one twin, A, who happened to be at a town in Scotland, bought a set of champagne glasses which caught his attention, as a surprise for his brother B; while, at the same time, B, being in England, bought a similar set of precisely the same pattern as a surprise for A. Other anecdotes of a like kind have reached me about these twins.

The last point to which I shall allude regards the tastes and dispositions of the thirty-five pairs of twins. In sixteen cases — that is, in nearly one-half of them — these were described as closely similar; in the remaining nineteen they were much alike, but subject to certain named differences. These differences belonged almost wholly to such groups of qualities as these: the one was the more vigorous, fearless, energetic; the other was gentle, clinging, timid; or the one was more ardent, the other more calm and placid; or again, the one was the more independent, original, and self-contained; the other the more generous, hasty, and vivacious. In short, the difference was that of intensity or energy in one or other of its protean forms; it did not extend more deeply into the structure of the characters. The more vivacious might be subdued by ill-health, until he assumed the character of the other; or the latter might be raised by excellent health to that of the former. The difference was in the key-note, not in the melody.

It follows from what has been said concerning the similar dispositions of the twins, the similarity in the associations of their ideas, of their special ailments and of their illness generally, that the resemblances are not superficial, but extremely intimate. I have only two cases of strong bodily resemblance being accompanied by mental diversity, and one case only of the converse kind. It must be remembered that the conditions which govern extreme likeness between twins are not the same as those between ordinary brothers and sisters, and that it would be incorrect to conclude from what has just been said about the twins that mental and bodily likeness are invariably coördinate, such being by no means the case.

We are now in a position to understand that the phrase "close similarity" is no exaggeration, and to realize the value of the evidence I am about to adduce. Here are thirty-five cases of twins who were "closely alike" in body and mind when they were young, and who have been reared exactly alike up to their early manhood and womanhood. Since then the conditions of their lives have changed. What change of nurture has produced the most variation?

It was with no little interest that I searched the records of the thirty-five cases for an answer; and they gave an answer that was not altogether direct, but it was distinct, and not at all what I had expected. They showed me that in some cases the resemblance of body and mind had continued unaltered up to old age, notwithstanding very different conditions of life; and they showed in the other cases that the parents ascribed such dissimilarity as there was, wholly or almost wholly, to some form of illness. In four cases it was scarlet fever; in a fifth, typhus; in a sixth, a slight effect was ascribed to a nervous fever; in a seventh it was the effect of an Indian climate; in an eighth, an illness (unnamed) of nine months' duration; in a ninth, varicose veins; in a tenth, a bad fracture of the leg, which prevented all active exercise afterwards; and there were three additional instances of undefined forms of ill-health. It will be sufficient to quote one of the returns; in this the father writes:

"At birth they were exactly alike, except that one was born with a bad varicose affection, the effect of which had been to prevent any violent exercise, such as dancing or running, and, as she has grown older, to make her more serious and thoughtful. Had it not been for this infirmity, I think the two would have been as exactly alike as it is possible for two women to be, both mentally and physically; even now they are constantly mistaken for one another."

In only a few cases is some allusion made to the dissimilarity being partly due to the combined action of many small influences, and in none of the thirty-five cases is it largely, much less wholly, ascribed to that cause. In not a single instance have I met with a word about the growing dissimilarity being due to the firm freewill of one or both of the twins, which had triumphed over natural tendencies; and yet a large proportion of my correspondents happen to be clergymen, whose bent of mind is opposed, as I feel assured from the tone of their letters, to a necessitarian view of life.

It has been remarked that a growing diversity between twins may be ascribed to the tardy development of naturally diverse qualities; but we have a right, upon the evidence I have received, to go farther than this. We have seen that a few twins retain their close resemblance through life; in other words, instances do exist of an apparently thorough similarity of nature, in which such difference of external circumstances as may be consistent with the ordinary conditions of the same social rank and country do not create dissimilarity. Positive evidence, such as this, cannot be outweighed by any amount of negative evidence. Therefore, in those cases where there is a growing diversity, and where no external cause can be assigned either by the twins themselves or by their family

for it, we may feel sure that it must be chiefly or altogether due to a want of thorough similarity in their nature. Nay, further, in some cases, it is distinctly affirmed that the growing dissimilarity can be accounted for in no other way. We may, therefore, broadly conclude that the only circumstance, within the range of those by which persons of similar conditions of life are affected, that is capable of producing a marked effect on the character of adults, is illness or some accident which causes physical infirmity. The twins who closely resembled each other in childhood and early youth, and were reared under not very dissimilar conditions, either grow unlike through the development of natural characteristics which had lain dormant at first, or else they continue their lives, keeping time like two watches, hardly to be thrown out of accord except by some physical jar. Nature is far stronger than Nurture within the limited range that I have been careful to assign to the latter.

The effect of illness, as shown by these replies, is great, and well deserves further consideration. It appears that the constitution of youth is not so elastic as we are apt to think, but that an attack, say of scarlet fever, leaves a permanent mark, easily to be measured by the present method of comparison. This recalls an impression made strongly on my mind several years ago, by the sight of some curves drawn by a mathematical friend. He took monthly measurements of the circumference of his children's heads during the first few years of their lives, and he laid down the successive measurements on the successive lines of a piece of ruled paper, by taking the edge of the paper as a base. He then joined the free ends of the lines, and so obtained a curve of growth. These curves had, on the whole, that regularity of sweep that might have been expected, but each of them showed occasional halts, like the landing-places on a long flight of stairs. The development had been arrested by something, and was not made up by after-growth. Now, on the same piece of paper, my friend had also registered the various infantine illnesses of the children, and corresponding to each illness was one of these halts. There remained no doubt in my mind that, if these illnesses had been warded off, the development of the children would have been increased by almost the precise amount lost in these halts. In other words, the disease had drawn largely on the capital, and not only on the income, of their constitutions. I hope these remarks may induce some men of science to repeat similar experiments on their children of the future. They may compress two years of a child's history on one side of a ruled half-sheet of foolscap paper, if they cause each successive line to stand for a successive month, beginning from the birth of the child; and if they economize space by laying, not the 0-inch division of the tape against the edge of the pages, but, say, the 10-inch division.

The steady and pitiless march of the hidden weaknesses in our constitutions, through illness to death, is painfully revealed by these histories of twins. We are too apt to look upon illness and death as capricious events, and there are some who ascribe them to the direct effect of supernatural interference, whereas the fact of the maladies of two twins being continually alike shows that illness and death are necessary

incidents in a regular sequence of constitutional changes beginning at birth, and upon which external circumstances have, on the whole, very small effect. In cases where the maladies of the twins are continually alike, the clocks of their two lives move regularly on at the same rate, governed by their internal mechanism. When the hands approach the hour, there are sudden clicks, followed by a whirring of wheels; the moment that they touch it, the strokes fall. Necessitarians may derive new arguments from the life histories of twins.

We will now consider the converse side of our subject, which appears to me even the more important of the two. Hitherto we have investigated cases where the similarity at first was close, but afterwards became less; now we will examine those in which there was great dissimilarity at first, and will see how far an identity of nurture in childhood and youth tended to assimilate them. As has been already mentioned, there is a large proportion of cases of sharply contrasted characteristics, both of body and mind, among twins. I have twenty such cases, given with much detail. It is a fact that extreme dissimilarity, such as existed between Esau and Jacob, is a no less marked peculiarity in twins of the same sex than extreme similarity. On this curious point, and on much else in the history of twins, I have many remarks to make, but this is not the place to make them.

The evidence given by the twenty cases above mentioned is absolutely accordant, so that the character of the whole may be exactly conveyed by a few quotations:

1. One parent says: "They have had *exactly the same nurture* from their birth up to the present time; they are both perfectly healthy and strong, yet they are otherwise as dissimilar as two boys could be, physically, mentally, and in their emotional nature."

2. "I can answer most decidedly that the twins have been perfectly dissimilar in character, habits, and likeness from the moment of their birth to the present time, though they were nursed by the same woman, went to school together, and were never separated till the age of fifteen."

3. "They have never been separated, never the least differently treated in food, clothing, or education; both teethed at the same time, both had measles, whooping-cough, and scarlatina at the same time, and neither had any other serious illness. Both are and have been exceedingly healthy and have good abilities, yet they differ as much from each other in mental cast as any of my family differ from another."

4. "Very dissimilar in body and mind; the one is quiet, retiring, and slow but sure; good-tempered, but disposed to be sulky when provoked; — the other is quick, vivacious, forward, acquiring easily and forgetting soon; quick-tempered and choleric, but quickly forgetting and forgiving. They have been educated together and never separated."

5. "They were never alike either in body or mind and their dissimilarity increases daily. The external influences have been identical; they have never been separated."

6. "The two sisters are very different in ability and disposition. The

one is retiring but firm and determined; she has no taste for music or drawing. The other is of an active, excitable temperament; she displays an unusual amount of quickness and talent, and is passionately fond of music and drawing. From infancy, they have been rarely separated even at school, and as children visiting their friends, they always went together."

7. "They have been treated exactly alike; both were brought up by hand; they have been under the same nurse and governess from their birth, and they are very fond of each other. Their increasing dissimilarity must be ascribed to a natural difference of mind and character, as there has been nothing in their treatment to account for it."

8. "They are as different as possible. (A minute and unsparing analysis of the characters of the two twins is given by their father, most instructive to read, but impossible to publish without the certainty of wounding the feelings of one of the twins, if these pages should chance to fall under his eyes.) They were brought up entirely by hand, that is, on cow's milk, and treated by one nurse in precisely the same manner."

9. "The home-training and influence were precisely the same, and therefore I consider the dissimilarity to be accounted for almost entirely by innate disposition and by causes over which we have no control."

10. "This case is, I should think, somewhat remarkable for dissimilarity in physique as well as for strong contrast in character. They have been unlike in body and mind throughout their lives. Both were reared in a country house, and both were at the same schools till *aet.* 16."

11. "Singularly unlike in body and mind from babyhood; in looks, dispositions, and tastes they are quite different. I think I may say the dissimilarity was innate, and developed more by time than circumstance."

12. "We were never in the least degree alike. I should say my sister's and my own character are diametrically opposed, and have been utterly different from our birth, though a very strong affection subsists between us."

13. The father remarks: "They were curiously different in body and mind from their birth."

14. The surviving twin (a senior wrangler of Cambridge) adds: "A fact struck all of our school contemporaries, that my brother and I were complementary, so to speak, in point of ability and disposition. He was contemplative, poetical, and literary to a remarkable degree, showing great power in that line. I was practical, mathematical, and linguistic. Between us we should have made a very decent sort of a man."

I could quote others just as strong as these, in some of which the above phrase "complementary" also appears, while I have not a single case in which my correspondents speak of originally dissimilar characters having become assimilated through identity of nurture. However, a somewhat exaggerated estimate of dissimilarity may be due to the tendency of relatives to dwell unconsciously on distinctive peculiarities, and to disregard the far more numerous points of likeness that would first attract the notice of a stranger. Thus in case 11, I find the remark, "Strangers see a strong likeness between them, but no one who knows them well can per-

ceive it." Instances are common of slight acquaintances mistaking members, and especially daughters of a family for one another, between whom intimate friends can barely discover a resemblance. Still, making reasonable allowance for unintentional exaggeration, the impression that all this evidence leaves on the mind is one of some wonder whether nurture can do anything at all, beyond giving instruction and professional training. It emphatically corroborates and goes far beyond the conclusions to which we had already been driven by the cases of similarity. In those, the causes of divergence began to act about the period of adult life, when the characters had become somewhat fixed; but here the causes conducive to assimilation began to act from the earliest moment of the existence of the twins, when the disposition was most pliant, and they were continuous until the period of adult life. There is no escape from the conclusion that nature prevails enormously over nurture when the differences of nurture do not exceed what is commonly to be found among persons of the same rank of society and in the same country. My fear is that my evidence may seem to prove too much, and be discredited on that account, as it appears contrary to all experience that nurture should go for so little. But experience is often fallacious in ascribing great effects to trifling circumstances. Many a person has amused himself with throwing bits of stick into a tiny brook and watching their progress; how they are arrested, first by one chance obstacle, then by another; and again, how their onward course is facilitated by a combination of circumstances. He might ascribe much importance to each of these events, and think how largely the destiny of the stick had been governed by a series of trifling accidents. Nevertheless all the sticks succeed in passing down the current, and in the long run, they travel at nearly the same rate. So it is with life, in respect to the several accidents which seem to have had a great effect upon our careers. The one element, that varies in different individuals, but is constant in each of them, is the natural tendency; it corresponds to the current of the stream, and inevitably asserts itself.

Much stress is laid on the persistence of moral impressions made in childhood, and the conclusion is drawn, that the effects of early teaching must be important in a corresponding degree. I acknowledge the fact, so far as has been explained in the chapter on Early Sentiments, but there is a considerable set-off on the other side. Those teachings that conform to the natural aptitudes of the child leave much more enduring marks than others. Now, both the teachings and the natural aptitudes of the child are usually derived from its parents. They are able to understand the ways of one another more intimately than is possible to persons not of the same blood, and the child instinctively assimilates the habits and ways of thought of its parents. Its disposition is "educated" by them, in the true sense of the word; that is to say, it is evoked, not formed by them. On these grounds I ascribe the persistence of many habits that date from early home education, to the peculiarities of the instructors rather than to the period when the instruction was given. The marks left on the memory by the instructions of a foster-mother are soon sponged clean away. Consider the history of the cuckoo, which is reared ex-

clusively by foster-mothers. It is probable that nearly every young cuckoo, during a series of many hundred generations, has been brought up in a family whose language is a chirp and a twitter. But the cuckoo cannot or will not adopt that language, or any other of the habits of the foster-parents. It leaves its birth-place as soon as it is able, and finds out its own kith and kin, and identifies itself henceforth with them. So utterly are its earliest instructions in an alien bird-language neglected, and so completely is its new education successful, that the note of the cuckoo tribe is singularly correct.

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